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Draft Environmental Impact Statement
Cummins Creek Project
Fayette County, Texas

(U.S.) Environmental Protection Agency
Dallas, TX

Apr 85

U.S. Department of Commerce
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Environmental Protection
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Region 6
1201 Elm Street
Dallas TX 75270

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April 1985

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Water

EPA

Environmental Impact Statement

Draft

Cummins Creek Project
Fayette County, Texas

MINING evaluation LaGrange GIDDINGS Rabbs Creek
Colorado River effects Schulenburg public hearing Flatonia
ROUND TOP RECLAMATION Waldeck REVIEW impact
CONSTRUCTION OLDENBURG comments Lexington
Fayetteville FINAL EIS LEDBETTER Units 3 & 4 Weimar
Carmine Overland Conveyor Cummins Creek Alternatives
Brenham NPDES Permit RUTERSVILLE Owl Creek
record of decision I ITE COORDINATION
Warrenton *scoping* Burton draft eis operation Columbus

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EPA is considering issuance of NPDES permits for the Cummins Creek Project. The surface lignite mine is proposed to provide fuel for two 400 MW steam electric generation units during the 37-year mine life. A 12-mile overland conveyor system would link the mine with the Fayette Power Plant. The total acreage to be disturbed by mining and mine support facilities is an estimated 10,000 acres. The maximum mining depth would be approximately 400 feet. After mining the land would be returned to its approximate original contour with the exception of a large overburden stockpile and an end lake. Notable effects associated with the project include: increased emissions of particulates, sulfur dioxide, nitrogen oxides and radionuclides; degradation to surface water and groundwater quality; alterations in surface water runoff and groundwater infiltration; increased noise levels; increased erosion and loss of soils including prime farmlands; loss of cultural resources; increased tax revenues for the Round Top-Carmine ISD; increased incomes from mining leases and royalties; increased employment opportunities; visual and aesthetic degradation; loss of fish and wildlife resources; and disruptions and changes within local communities and families directly and indirectly affected. Many of these project affects will result in adverse impacts and irreversible loss on natural resources.

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United States
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Region 6
1201 Elm Street
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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION VI
1201 ELM STREET
DALLAS, TEXAS 75270

April 2, 1985

TO ALL INTERESTED AGENCIES, OFFICIALS, PUBLIC GROUPS AND INDIVIDUALS:

The U.S. Environmental Protection Agency (EPA) has prepared this Draft Environmental Impact Statement (EIS) concerning issuance of new source National Pollutant Discharge Elimination System (NPDES) permits for wastewater discharges from the Cummins Creek Project in Fayette County, Texas. The project includes a lignite mine, an overland conveyor system and units 3 and 4 of Fayette Power Project. The document has been prepared in compliance with the National Environmental Policy Act of 1969 and implementing regulations.

EPA will hold a public hearing on the Draft EIS on June 6, 1985, at 7:00 p.m., in the La Grange Independent School District Auditorium, located on State Highway 71, in La Grange, Texas. EPA requests that individuals and representatives of groups planning to make a statement at this hearing please submit a written copy at the time of the hearing.

Comments on the Draft EIS will be considered in the preparation of the Final EIS. If the required changes are minor, EPA's Final EIS will incorporate the Draft EIS by reference and include only: (1) a revised summary, (2) revisions necessary to the Draft EIS as a result of public comment, (3) EPA's responses to comments made on the Draft EIS, and (4) EPA's preferred actions. Therefore, the Draft EIS should be retained for possible use in conjunction with the Final EIS. The Final EIS will be sent only to those who request a copy or who make substantive comments on the Draft EIS.

In cases where persons requested only a copy of the summary of the Draft EIS, this transmittal letter accompanies that summary.

The Draft EIS as well as some support material for the Cummins Creek Project may be reviewed at various depositories in the project area (see enclosed list).

Written comments or inquiries regarding this EIS should be addressed to Mr. Clinton B. Spotts, Regional EIS Coordinator, at the above address by the date stamped on the cover sheet following this letter.

Sincerely yours,

Dick Whittington

Dick Whittington, P.E.
Regional Administrator

Enclosure

DEPOSITORIES FOR
CUMMINS CREEK DRAFT EIS

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County Courthouse

Burton

Ms. Stevelyn Kloecker
City Hall

Carmine

Jack Flynn
Round Top-Carmine ISD Superintendent's Office
Spur 458

Municipal Judge's Office
Municipal Building

Columbus

City Manager's Office
Municipal Building
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Fayetteville

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Flatonia

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City Hall
125 East South Main Street

Giddings

Office of City Manager
118 E. Richmond Street

La Grange

Office of City Manager
City Hall
155 E. Colorado

Irene Protka
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Kathy Carter
Fayette County Heritage Museum and Archives
855 South Jefferson

Ledbetter

Val Thornton
Ledbetter Store

Lexington

Office of Mayor
Main and 4th Street

Nechanitz

Matejowsky Store

Oldenburg

Oldenburg Country Store
Highway 237

Round Top

Klump's Grocery
Highway 237

Rutersville

Tietjen's Store

Schulenburg

Jackie Machac
Western Auto Store
531 North Main Street

Waldeck

General Store

Warrenton

Warrenton Grocery
Highway 237

Meinen's Station
Highway 237

Weimar

City Manager's Office
City Hall
106 E. Main

DRAFT ENVIRONMENTAL IMPACT STATEMENT
CUMMINS CREEK PROJECT
FAYETTE COUNTY, TEXAS

RESPONSIBLE AGENCY: U.S. Environmental Protection Agency, Region 6

COOPERATING AGENCIES: U.S. Soil Conservation Service, U.S. Corps of Engineers, U.S. Fish & Wildlife Service, Texas Department of Health, Texas Historical Commission, Railroad Commission of Texas, Texas Department of Highways and Public Transportation, and Texas Parks and Wildlife Department.

ADMINISTRATIVE ACTION: Issuing New Source National Pollutant Discharge Elimination System (NPDES) permits to the Lower Colorado River Authority (LCRA) for discharges of wastewater from Units 3 and 4 of the Fayette Power Project (FPP) and the Cummins Creek Surface Lignite Mine.

EPA CONTACT:
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1201 Elm Street
Dallas, Texas 75270
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ABSTRACT: EPA is considering issuance of NPDES permits for the Cummins Creek Project. The surface lignite mine is proposed to provide fuel for two 400 MW steam electric generation units during the 37-year mine life. A 12-mile overland conveyor system would link the mine with the FPP. The total acreage to be disturbed by mining and mine support facilities/activities is an estimated 10,000 acres. The maximum mining depth would be approximately 380 to 400 feet. After mining the land would be returned to its approximate original contour with the exception of a large overburden stockpile and an end lake. Notable effects associated with the project include: increased emissions of particulates, sulfur dioxide, nitrogen oxides and radionuclides; degradation to surface water and groundwater quality; alterations in surface water runoff and groundwater infiltration; increased noise levels; increased erosion and loss of soils including prime farmlands; loss of cultural resources; increased tax revenues for the Round Top-Carmine ISD; increased incomes from mining leases and royalties; increased employment opportunities; visual and aesthetic degradation; loss of fish and wildlife resources; and disruptions and changes within local cummunities and families directly and indirectly affected. Many of these project effects will result in major, long-term or short-term adverse impacts. Some effects will result in an irreversible loss of certain natural resources. Measures to reduce or monitor potential adverse impacts are discussed for specific elements or resources.

COMMENTS ON DRAFT EIS DUE:

RESPONSIBLE OFFICIAL:

Dick Whittington

Dick Whittington, P.E.
Regional Administrator

PREFACE

This Environmental Impact Statement (EIS) was prepared by Region 6 of the Environmental Protection Agency with the assistance of Lee Wilson and Associates, Inc. in the areas of air quality, geology, biological resources, groundwater and surface water (worst-case analyses). The project descriptions and baseline data utilized in the impact evaluation were supplied by the Lower Colorado River Authority, the permit applicant. In those instances where other data and/or information were used, the source is indicated. Except for the discussion on cumulative impacts, the evaluations address the proposed Cummins Creek Surface Lignite Mine, Units 3 and 4 of the Fayette Power Project, and the Curved Overland Conveyor System, referred to collectively in this EIS as the Cummins Creek Project.

EPA approved early construction of Unit 3 subject to the terms and conditions of the signed agreement included in Appendix A.

EPA has also approved with stipulations, early construction of the Cummins Creek Lignite Mine Support Facility (i.e. the site to erect a dragline and bucketwheel excavator as well as an access road, surface water control structures and topsoil stockpile) and the upgrading of approximately 1-1/2 miles of County Road 133. See EPA's letter in Chapter 4, Significant Correspondence.

Intermittent Stream - Cummins Creek

SUMMARY

SUMMARY

Background. The National Environmental Policy Act of 1969 (NEPA), requires that all Federal agencies prepare Environmental Impact Statements (EIS's) on major actions significantly affecting the quality of the human environment. The Clean Water Act (CWA) mandates that the requirements of NEPA apply to the issuance of a permit for discharging any pollutant by a "New Source". The Environmental Protection Agency (EPA) determined that issuing new source National Pollutant Discharge Elimination System (NPDES) permits to the Lower Colorado River Authority (LCRA) for the proposed Fayette Power Project, Units 3 and 4, and the Cummins Creek Lignite Mine represented a major Federal action significantly affecting the quality of the human environment. This EIS assesses the potential environmental consequences of EPA's permit actions.

Alternatives. Taking no action was evaluated, in addition to use of numerous energy sources, siting and design options, mining methods, transportation systems and routes, mining technologies and reclamation alternatives. Energy sources such as solar thermal conversion, wind power, hydroelectric development, nuclear power, coal slurry pipeline, natural gas and western coal were evaluated and eliminated as being technologically infeasible, unreliable or not cost-effective. Developing lignite resources in both the Cummins Creek and Rabbs Creek areas were evaluated. Alternative mining methods considered included underground mining, auger mining and surface mining. Transportation system alternatives including overland conveyor, trucks, commercial trains and a slurry pipeline for transporting the lignite from the mining area to the power plant were evaluated. Eight alternative routes for the overland conveyor were assessed. Detailed evaluation of three mining technologies (bucket wheel excavators, draglines and a combination of bucket wheel excavators and draglines) was undertaken. Reclamation alternatives considered included the use of topsoil over oxidized overburden, a topsoil-subsoil mix, a random mix of topsoil, subsoil and overburden and selective overburden strata.

Alternatives available to EPA are: 1) issue the NPDES permits as proposed; 2) issue the NPDES permits with modifications to minimize adverse impacts; or 3) deny the NPDES permits.

Proposed Project. The proposed Cummins Creek Project would consist of a surface lignite mine, haul roads, associated mine support facilities, 12.1 miles of overland conveyor and two additional 400 MW lignite-fired steam electric generation units at the Fayette Power Project (FPP). Units 3 and 4 of the FPP would be located near La Grange, Texas, while the mine would be located in northern Fayette County, between the towns of Nechanitz and Ledbetter. The total acreage to be disturbed by mining and supporting activities is approximately 10,000 acres over a 37-year mining period. Total amounts of lignite to be removed would be about 221 million tons. Construction activites for the mine are proposed to be initiated in 1985 with actual mining commencing in 1987. The maximum depth of mining would be about 400 feet. Both bucket wheel excavators and draglines would be utilized for burden removal. Scrapers, dozers, continuous surface miners, etc., would be used to assist in overburden handling and lignite loading. Haul trucks would be used for transporting lignite to the mine conveyor system, which in turn would transport the lignite to the overland conveyor system. The overland conveyor system would transport the lignite from the mine to the FPP.

Prior to mining the land would be cleared of all vegetation. The development of the mine would require the diversion of Cummins Creek and the construction of 37 ponds and 23 ditches to control runoff from disturbed and undisturbed areas. After mining the land would be returned to its approximate original contour with the exception of a large permanent overburden stockpile (covering approximately 1,352 surface acres with maximum height of 130 feet above the original surface) and an 845-acre end-lake. Generally, reclamation would involve placing one foot of topsoil over three feet of randomly mixed subsoil or overburden material and revegetating with grasses and trees, subject to individual landowner preferences.

The two additional electric generation units (3 and 4) would be located at the present power plant site, immediately adjacent to existing Units 1 and 2. Presently, construction of Unit 3 is 15% complete with operation scheduled for January 1988, and Unit 4 is tentatively scheduled for mid-summer 1991. All four units would utilize the existing 2,400-acre cooling reservoir. Construction of Units 3 and 4 would disturb approximately 210 acres. This includes the initial combustion by-products disposal area, areas for construction of the plant site lignite, fly ash and bottom ash handling areas, all pond construction and the construction of the units in the power block.

Environmental Consequences. The major environmental consequences of the proposed project, if implemented, are shown on Table S-1.

TABLE S-1

Summary of Environmental Consequences

Environmental Category	Effect and Impact Assessment of Proposed Mine, Conveyor and Units 3 & 4
Terrestrial Biology	Habitat removal and alteration of the ecosystem, and loss or displacement of wildlife during mining, followed by the slow reestablishment of habitat and species after reclamation, constitute major short-term and long-term adverse impacts. Damage to and loss of habitat and wildlife from construction of the overland conveyor and Units 3 and 4 constitute minor adverse impacts. Power plant operation should have no measureable effects or impacts on wildlife or vegetation. However, limited and unquantifiable adverse impacts attributable to acid deposition from the combination of sources existing and proposed for the area are foreseeable.
Aquatic Biology	The numerous creek segments and ponds disturbed or destroyed by mining, followed by reclamation and eventual reestablishment, constitute major long-term adverse impacts on about 500 surface acres of stream/riparian habitats. Total surface water acreages would increase from 150 to 980 acres, constituting a long-term beneficial impact. Increased temperatures in Cedar Creek Reservoir from Units 3 and 4 effluent could cause beneficial impacts in winter and adverse impacts in summer on the lake fishery. Concentrations of selenium, mercury, lead and/or cadmium from power plant operation could potentially affect sensitive aquatic species in a worst-case situation, constituting an adverse impact. Reduced flows from end-lake and flood control structures constitute adverse impacts on riparian habitats.
Geology	Modification of the natural stratigraphy, depletion of lignite reserves, and the irretrievable loss of gravel deposits from mining constitute long-term adverse impacts. Conveyor and power plant construction would displace surface and shallow subsurface sediments, resulting in minor long-term adverse impacts.
Topography	Small alterations throughout the mine area and significant changes resulting from the permanent overburden stockpile, end-lake, surface water control structures and Cummins Creek diversion constitute major long-term adverse impacts. Alterations in the conveyor right-of-way from construction constitute major or minor short-term and long-term adverse impacts. Alterations at the power plant site will result in minor adverse impacts.

Schools	A potential increase in enrollment at Brenham ISD which could require additional facilities constitutes minor short-term adverse impacts. The Round Top-Carmine ISD should realize a net gain in tax revenues from the mined area, constituting long-term beneficial impacts. However, mining could affect Round Top-Carmine ISD bus routes creating periodic major adverse impacts.
Fiscal Resources	Increased incomes from mining leases and royalties constitute beneficial impacts on property owners. Increased property taxes resulting from loss of agricultural status on mined lands for an estimated 17 years (including 5-yr "roll-back") constitute major long-term adverse impacts on property owners. Increased land values could result in a decrease in tax rates in Fayette County, the Round Top-Carmine ISD, the town of Round Top and the Lee-Fayette Cummins Creek WCID #9, constituting a long-term beneficial impact on landowners within these taxing jurisdictions. Loss of oil and gas operations during mining constitutes short-term and long-term adverse impacts on property owners and taxing jurisdications. Potential increases in sales tax revenues from secondary business activities constitute beneficial impacts on taxing jurisdictions in certain communities. Compensation from the overland conveyor easement constitutes a beneficial impact on property owners. Units 3 and 4 should not impact fiscal resources.
Employment	Direct employment opportunities (projected 1,500 workers, with about 350 already working on Unit 3) constitute major short-term and long-term beneficial impacts. Indirect employment opportunities in local towns and communities from expanding business sectors constitute additional beneficial impacts.
Social and Cultural Patterns	New residents could induce changes in local communities and populations, constituting short-term adverse impacts.
Noise	Increased noise levels caused by the mine, overland conveyor and/or Units 3 and 4 constitute periodic minor or major adverse impacts on nearby receptors. The predicted levels are generally categorized as unacceptable to about 20 percent of the people affected and in a range that results in some complaints to authorities.
Transportation	Closing and relocating county and farm-to-market roads around the mine constitute a major long-term adverse impact on local traffic patterns. The additional traffic on roadways, particularly on County Road 112 at the mine maintenance facilities area and on State Highway 71 during shift changes at the power plant constitute periodic long-term adverse impacts. Construction of overland conveyor at road crossings constitute short-term adverse impacts.

Soils	Mining and reclamation would result in soil losses, including prime farmland soils, which constitute an irretrieveable commitment of this resource and a long-term adverse impact. Additional prime farmland soils would be lost within the conveyor right-of-way causing a long-term adverse impact. Soil loss from erosion during construction of Units 3 and 4 constitutes an adverse impact.
Air Quality	Increased fugitive dust and vehicle exhaust emissions during construction and operation of the mine and conveyor are projected to be negligible with no violation of air quality standards expected. Increased power plant emissions of sulfur dioxide (SO_2), nitrogen oxides (NO_x) and particulates (TSP) from Units 3 and 4 should not cause violation of air quality standards.
Public Health	For regulated air pollutants, increased power plant emissions would not cause adverse impacts to public health. Potential increases of non-regulated air pollutants (i.e., radionuclides and trace metals) in ambient air concentrations would be negligible with no adverse effects on health expected.
Surface Water	Increased sediment loads on creeks during mining and reclamation constitute minor short-term adverse impacts on water quality. Alterations in drainage patterns and flows in Cummins Creek and Rabbs Creek watersheds from mining and reclamation constitute minor long-term impacts. Reduced peak flows from end lake development and flood retarding structures constitute beneficial impacts on flood control in Cummins Creek watershed. Increased sediment to creeks during construction of overland conveyor or Units 3 and 4 constitute short-term adverse impacts. Concentrations of cadmium, lead, mercury and selenium from plant runoff which reach or exceed EPA criteria (worst-case analysis) constitute long-term adverse impacts. Increased temperatures in Cedar Creek reservoir from Units 3 and 4 effluent consititute seasonal adverse or beneficial impacts.
Groundwater	The interruption or loss of private wells during mining, and the lowering of the water table from dewatering or depressurization causing a lowering of water levels in private wells within an estimated two to three miles from the mine constitute major short-term or long-term adverse impacts. Degradation of groundwater quality from increased dissolved solids in private wells reestablished after mining constitutes major long-term adverse impacts. Slight increase in groundwater recharge rates due to increased vertical permeability of mixed overburden and end-lake development constitutes long-term beneficial impacts. Diminished aquifer productivity in reclaimed spoil areas due to decreased horizontal permeability of overburden material constitutes a long-term adverse impact. Construction or operation of the overland conveyor and Units 3 and 4 should not affect or impact groundwater resources.

Land Use/Productivity	Landowner survey indicates mining/reclamation would result in a 20% increase in pastureland. Changes in land use on reclaimed lands could cause secondary effects and impacts on other resources (e.g., fish and wildlife). Loss of land use within the overland conveyor right-of-way constitute a major long-term adverse impact. Since the FPP site is dedicated to power generation, Units 3 and 4 should have only minimal impact on land use. The potential increase in the use of fertilizer to maintain productivity on reclaimed lands, particularly in areas without topsoil, constitutes an adverse impact. The barrier created by the overland conveyor may restrict certain farm operations causing a minor or major long-term adverse impact. Units 3 and 4 operation may indirectly affect and reduce land productivity on nearby farmsteads, constituting a periodic long-term adverse impact.
Demography	The projected manpower requirements of the proposed mine, overland conveyor and Units 3 and 4 should help to maintain the recent trend of population increases, constituting a beneficial impact on demography.
Housing	Building activity could increase in local towns and cities to accommodate projected work forces. Construction phases could increase demands on temporary housing while operation work forces could affect more permanent, single family housing with rental property foreseen as a high priority. These effects constitute beneficial impacts on the housing market in the four county study area.
Recreation	No existing or proposed public recreational resources should be directly impacted by mining activities, with the possible exception of those individual farm ponds used for hunting or fishing. New residents would place additional demands on recreational resources constituting minor adverse impacts.
Aesthetic Values	Values of individuals, families, or groups affected by the proposed project, directly or indirectly, constitute minor and major short-term and long-term adverse impacts.
Cultural and Historic Resources	Mining and/or construction at the proposed lignite mine, overland conveyor, or Units 3 and 4 could affect known and unknown resources and cause minor or major long-term adverse impacts and/or an irretrieveable commitment of the resources or site. Where the importance of properties is protected through data recovery, excavation, etc., beneficial impacts could occur.

Pond Construction - Units 1 and 2, Fayette Power Project

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CHAPTER 1

INTRODUCTION, PURPOSE AND NEED

CHAPTER I INTRODUCTION, PURPOSE AND NEED

National Pollutant Discharge Elimination System (NPDES) permits must be obtained from the Environmental Protection Agency (EPA) before the discharging of any pollutant into navigable waters of the United States from designated sources in industrial categories for which new source performance standards have been promulgated. According to Section 511 (c)(1) of the Clean Water Act, the issuance of NPDES permits by EPA for new source discharges is subject to the National Environmental Policy Act (NEPA). The requirements of this Act may include the preparation of an Environmental Impact Statement (EIS). A notice of intent to prepare an EIS on the issuance of NPDES permits to the Lower Colorado River Authority (LCRA) for discharges of wastewater from the Fayette Power Project, Units 3 and 4, and the Cummins Creek Lignite Mine was issued by EPA on April 12, 1984.

This Draft EIS evaluates the environmental effects of project alternatives considered by LCRA as well as alternative permit actions available to EPA. EPA invites and encourages public review and comments on this Draft. Comments received will be considered by the Regional Administrator in preparing the Final EIS, and ultimately in making final decisions on EPA's NPDES permit actions.

Currently the Fayette Power Project (FPP) consists of two 600 MW units (Units 1 and 2) fueled by western coal along with a 2400 acre reservoir for power plant cooling. The LCRA is proposing to add two 400 MW units to be fueled by lignite from the Cummins Creek Lignite Mine. Commercial operation of Unit 3 is scheduled for January 1988 while Unit 4 is tentatively scheduled for mid-summer 1991.

With regard to Unit 3, LCRA requested and received permission to begin early construction of the unit as provided for the EPA's regulation [40 CFR 122.29(c)(4)(i)]. On June 26, 1984, LCRA entered into a legally binding early construction agreement with EPA. The agreement provides the following: LCRA agrees to comply with all EIS related requirements which may be contained in an NPDES permit for the unit; LCRA will cease any construction activity which is causing or expecting to cause significant adverse impact until necessary mitigation is developed and taken by the company. The agreement also states that LCRA is proceeding at its own risk with early construction of the unit; the agreement does not bind EPA to issue an NPDES permit for Unit 3 (see Appendix A).

LCRA has projected increasing demand for electrical energy. Its forecasts for future energy needs were developed by analyzing past trends in major demand and energy components. Table 1-1 shows the actual growth rate and the forecasted growth rate for both peak demand and energy.

TABLE 1-1
CUMMINS CREEK PROJECT
LCRA TOTAL SYSTEM ANNUAL GROWTH RATES

	Energy	Peak Demand
Actual (1976 to 1983)	7.6%	6.4%
Forecast (1984 to 1998)		
Upper Estimate	7.8%	7.1%
Lower Estimate	5.4%	4.8%

The actual annual energy consumption for 1970 through 1983 is shown in Figure 1-1 with both the upper and lower forecast estimates for 1984 through 1995.

The actual peak demand for 1970 through 1983 is shown in Figure 1-2 along with the forecast of future peak demand. The generation requirements shown include the capacity needed to meet the peak demand in addition to sales to other companies in Texas through 1984 and the reserve capacity needed for reliability.

Figure 1-3 indicates the amount of generation capacity that LCRA has in addition to that required to meet load plus reserve. This generation reserve level will be approximately 91 MW deficient in 1988. As the figure shows, 541 MW of generation will have to be added by 1991 if adequate generation capacity is to be available.

The present forecast is lower than recent trends of load data might indicate. The actual growth of the last five years is closer to the upper estimate than to the lower estimate. The expectation of a lesser growth rate is due to the following assumptions:

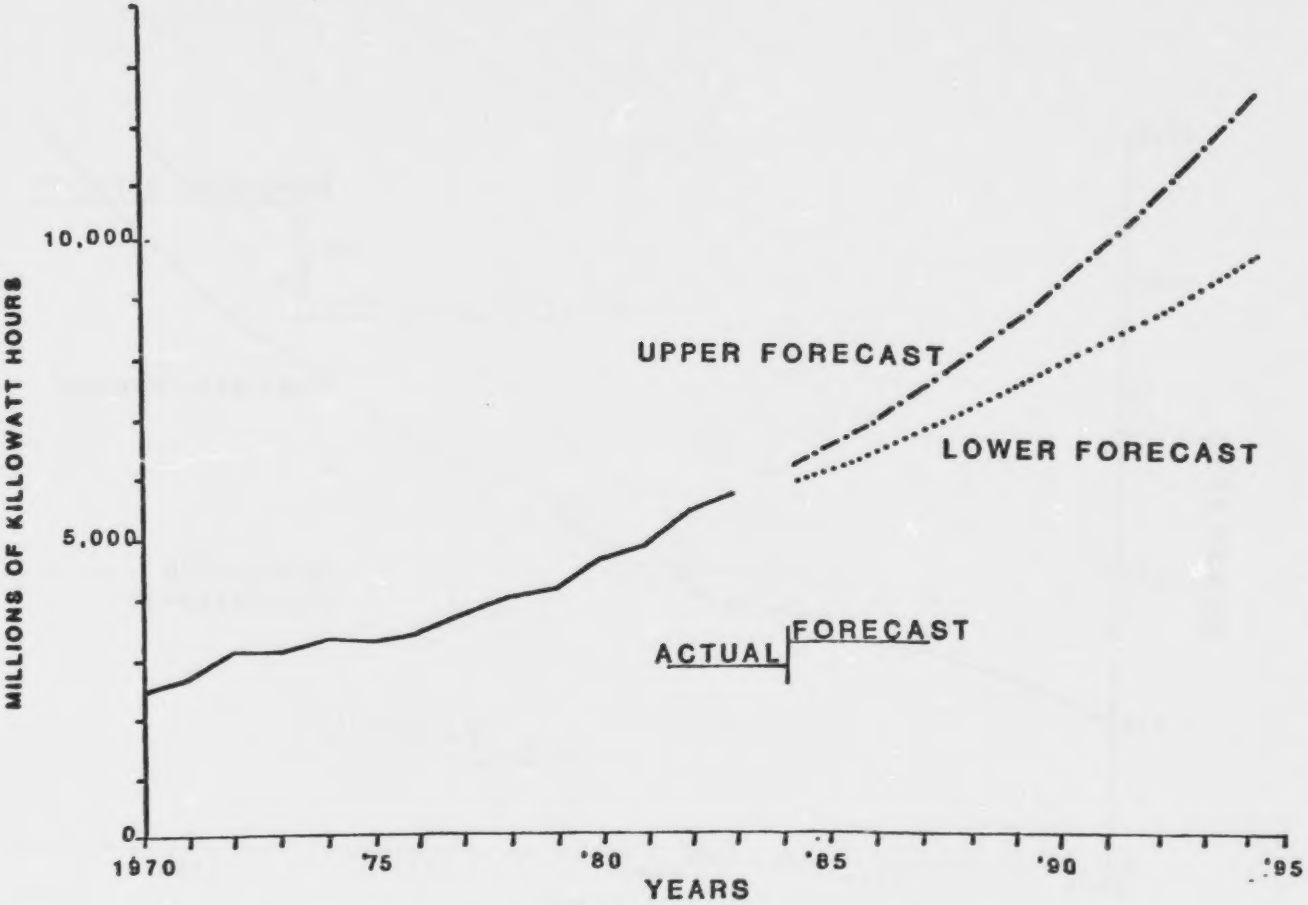
- ° Basic load growth will slow due to reduced growth in local industries (oil, cement).
- ° LCRA area population growth in the 1980s will be less rapid than in the 1970s, but will still be above the state's rate.
- ° There will be a continuing trend to add more efficient appliances (particularly heating and cooling systems).
- ° Individual customers will continue energy conservation efforts.

The evaluation of future demand must take the uncertainty of the future into account; hence, both a lower and upper forecast of the future energy conditions were developed. Sufficient facilities and fuel must be available to meet the upper energy forecast while ensuring that financial and contractual obligations can be met using the lower forecast.

The Lower Colorado River Authority is a member of the Electric Reliability Council of Texas (ERCOT). Members must maintain a level of reserve generating capacity to cover energy requirements during planned maintenance outages, unplanned outages, or unusually high load level periods.

Figure 1-1

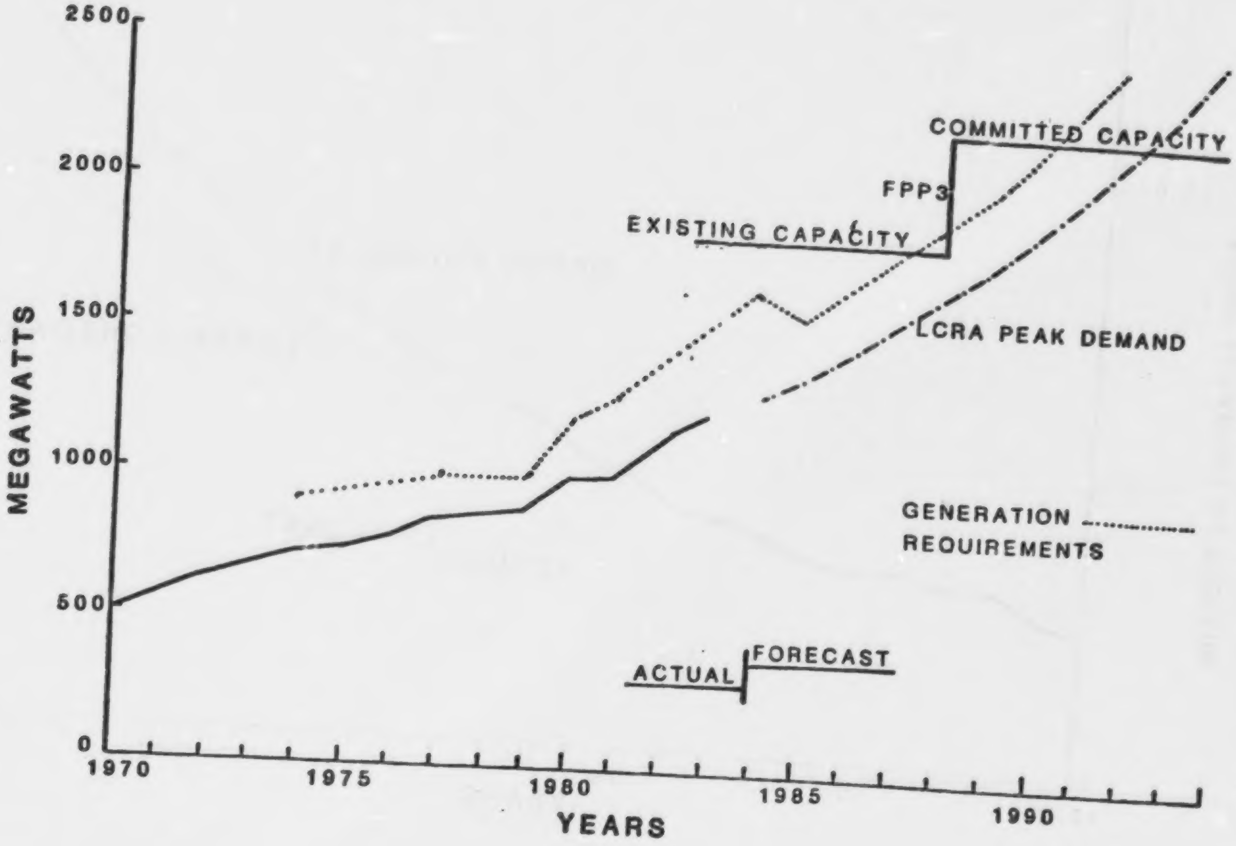
CUMMINS CREEK PROJECT
LCRA TOTAL ANNUAL ENERGY CONSUMPTION



Source: LCRA, 1984a

Figure 1-2

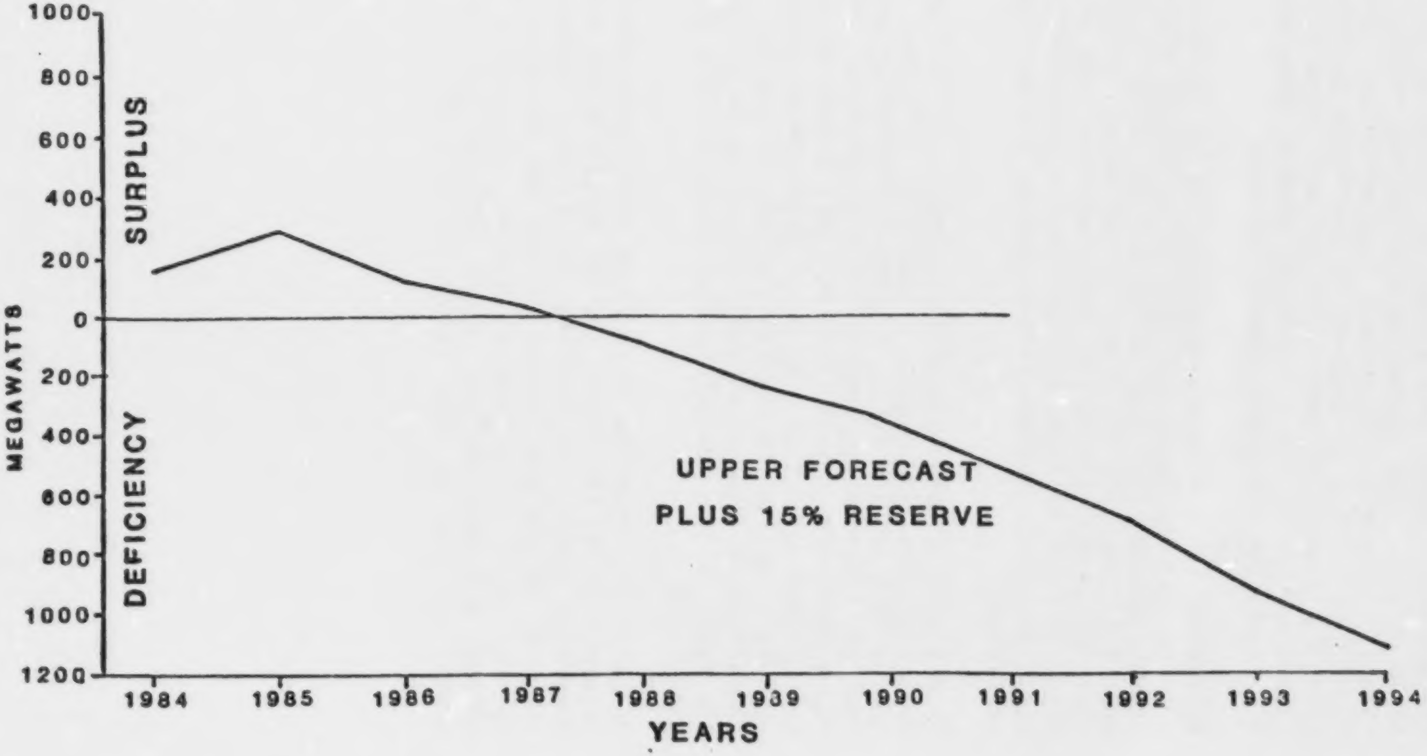
CUMMINS CREEK PROJECT
LCRA CAPACITY REQUIREMENTS



Source: LCRA, 1984a

Figure 1-3

CUMMINS CREEK PROJECT
LCRA EXISTING CAPACITY COMPARED TO REQUIREMENTS



Source: LCRA, 1984a

The members of ERCOT have agreed to plan for an overall reserve level of 15 percent. The planned generation requirements for the upper forecast include the 15 percent reserve target. Even though additional reserve levels may be required in the future because the new units being built are more complicated and more prone to unscheduled outages, LCRA continues to use a 15 percent reserve above the upper forecast as a criteria for additional generation need.

Following LCRA's economic assessment of the various alternatives available to meet the additional generating demands projected for the end of this decade, LCRA studied the effects delaying either Unit 3 or Unit 4 for one year would have on the overall project costs. The basic assumption behind this assessment was that if either new power plant unit was delayed, the shortfall of electricity on the LCRA system could be made up through term purchases of electricity from other utilities.

As discussed in the alternatives chapter, Units 3 and 4 represent the most cost effective method of supplying additional electrical energy to the LCRA service area. Any other alternative would have higher cost or, conversely, produce less cost savings. Table 1-2 provides the annual cost savings (for the first 9 years of operation) provided by LCRA owning Unit 3. Table 1-3 gives the projected savings provided by Unit 4 considering the existing 400 MW from Unit 3 in 1988. (Direct comparisons should not be made between Tables 1-2 and 1-3 as they are the result of independent studies using slightly different economic scenarios).

In delaying either new power plant unit, additional costs would be incurred due to the higher cost of obtaining electrical energy from an alternate source. In delaying Unit 4, still higher costs would be incurred through the loss of capital cost savings. These capital cost savings would be provided, as planned, via power plant components obtained through a delayed purchase option from the Unit 3 project and use of common construction labor forces for both units.

TABLE 1-2

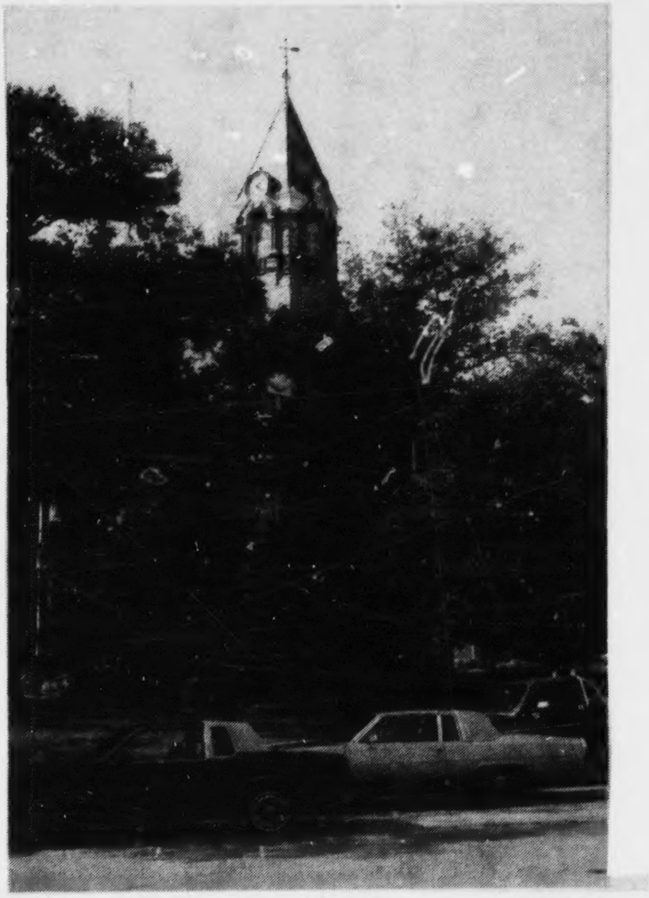
CUMMINS CREEK PROJECT
ANNUAL SAVINGS IN TOTAL SYSTEM COST WITH 400 MW OF UNIT 3 INSTALLED IN 1988 VERSES NO NEW UNITS (MILLIONS OF DOLLARS)

	No New Units	Unit 3 in 1988	Savings
1988	554	553	1
1989	666	621	45
1990	801	754	47
1991	951	874	77
1992	1121	1026	95
1993	1314	1206	108
1994	1570	1437	133
1995	1841	1692	149
1996	2150	1990	160

TABLE 1-3

CUMMINS CREEK PROJECT
ANNUAL SAVINGS IN TOTAL SYSTEM COST WITH 400 MW OF UNITS 4 INSTALLED IN 1991 VERSUS NO NEW UNITS (MILLIONS OF DOLLARS)

	No New Units	Unit 4 in 1991	Savings
1992	821	799	22
1993	975	945	30
1994	1169	1097	72
1995	1380	1303	77
1996	1621	1533	88
1997	1913	1789	124
1998	2301	2154	147



Fayette County Courthouse - LaGrange

CHAPTER 2

DESCRIPTION AND EVALUATION OF ALTERNATIVES

CHAPTER 2 DESCRIPTION AND EVALUATION OF ALTERNATIVES

Included in this chapter are discussions of the no action alternative (which projects future conditions without the project), the various alternative plans available to LCRA, the alternatives available to EPA and other agencies, and the specific alternatives being proposed by LCRA.

2.1 NO ACTION ALTERNATIVE

If LCRA should decide not to mine the Cummins Creek lignite reserve or not to construct either or both of the power plant units, the adverse and beneficial impacts described in Chapter 3 would not occur. Land use patterns and environmental conditions would probably remain much as they are today for a number of years in the future. In social and economic terms, however, the effects may be more noticeable if the project is not implemented. Some landowners may not realize as high a return from their land and the communities would not experience potential increases in tax income, the demands on services or the growth potential associated with the project (See Section 3.1). This of course, assumes that the demand for electricity remains at a level roughly equal to or greater than LCRA's projections (See Figure 1-3).

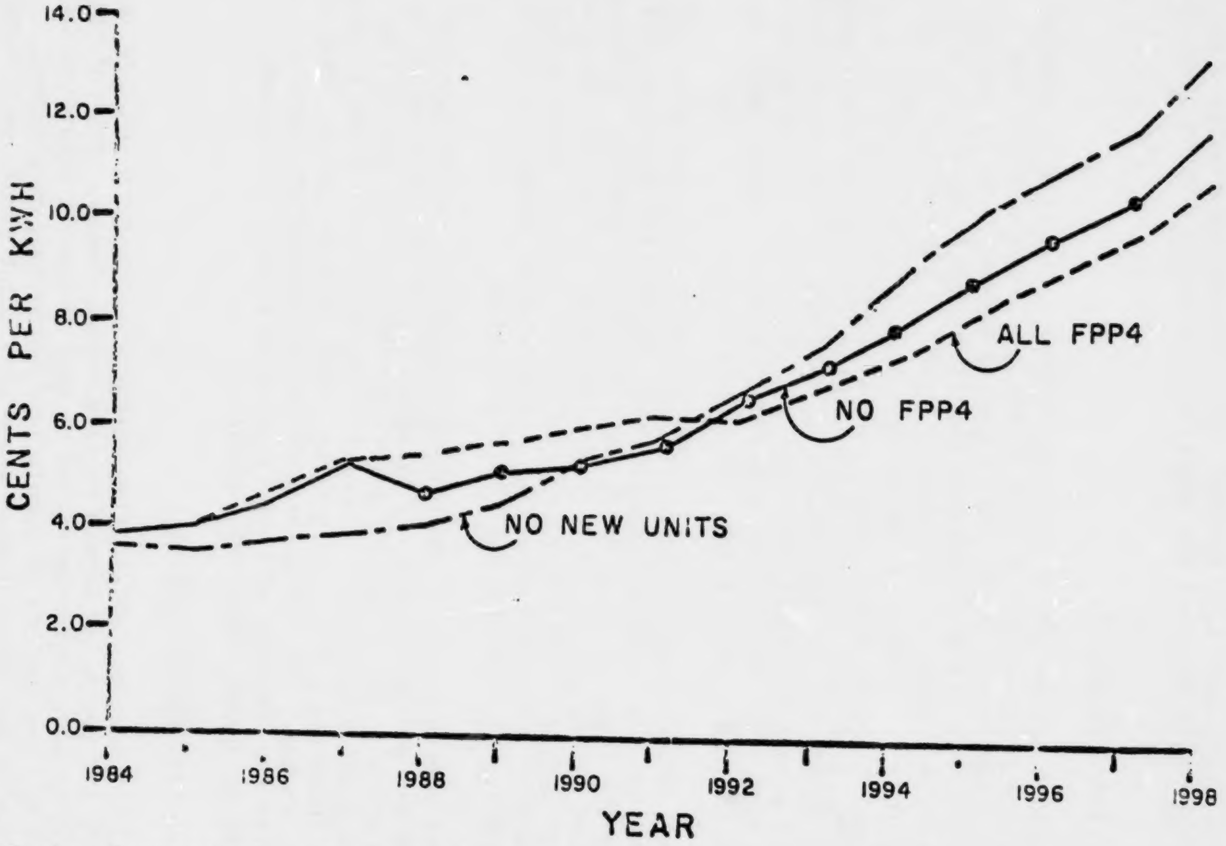
The effects of a decision not to proceed with the project which would be felt beyond the immediate project site communities would primarily relate to the costs of electricity paid by LCRA customers. LCRA concluded that lignite-fired steam generating power plants are the most economical method of generating electricity. The only other method LCRA considers feasible for meeting the increasing demand for electricity is to purchase electricity from other utilities.

Figure 2-1 presents LCRA's comparative projections of the costs of producing and generating elecricity under the no action alternative ("no new units"), the alternative of constructing only Unit 3 ("No FPP4"), and the alternative of constructing both Units 3 and 4 ("all FPP4"). These projections do not represent consumer costs. They do indicate, however, that since production and generation costs will be lowest with the addition of Units 3 and 4, the costs to consumers would also be lowest under this option.

2.2 ALTERNATIVE ENERGY SOURCES

LCRA analyzed numerous alternative energy sources which could be used to satisfy the projected demand for electrical energy. Some of the options which were evaluated failed to meet the goals regarding cost, availability, reliability of supply, and technology development. Biomass-fueled and refuse-fueled steam generating plants were eliminated from consideration because of the small generating capacity achievable, the unreliable fuel supply, and the high costs. Solar thermal conversion, photovoltaic conversion, and wind power were eliminated because of intermittent generating capacity, costly energy storage problems, large land use requirements, and high overall costs. Additional hydroelectric development in the LCRA service area is possible, but not to the extent necessary to meet the projected demand. Certain adverse

Figure 2-1
BUSBAR ENERGY COST* UPPER FORECAST



* Busbar Energy Cost - The cost of production and generation of energy. Includes capitalization costs but not energy transmission costs.

Source: LCRA, 1984a

environmental impacts are also associated with this power source, as with the option of nuclear power.

Several economic and management advantages were identified for nuclear power generation although a nuclear power generating plant could not be developed independently by LCRA within the required time frame. Although LCRA could meet the projected power demands by buying into the South Texas Nuclear Project, the legal and political risks were considered by LCRA to be prohibitive.

Cogeneration, the production of electricity by using wasted energy (steam) from industrial natural gas burning, was not an option considered by LCRA. It is not known whether sufficient industrial sources exist within a zone of economic feasibility to make this a viable option.

Another alternative energy source involves transporting coal to the Fayette Power Plant via a coal slurry pipeline. In such a system, finely ground coal is mixed with a liquid, generally water, to form a slurry. The mixture is then pumped through a pipeline to its destination, where the liquid and coal are separated. Energy Transportation Systems, Inc., (ETSI) was organized in 1973 to develop, build and operate a coal/water slurry pipeline that would transport low-sulfur western coal to power plants in the south-central U.S. for use as fuel in generating electricity. This proposed project was recently evaluated by the U.S. Army Corps of Engineers and other Federal agencies (including EPA) in connection with the preparation of a Draft Supplemental EIS. However, the need for future environmental review was nullified when ETSI withdrew the proposal.

Another type of coal slurry transport system uses liquid carbon dioxide (CO_2) instead of water. This process is still in the testing phase and the current pilot plants involve only short-distance commercial pipelines. The potential for using coal slurry pipelines in the south-central U.S. remains questionable.

In conclusion, it does not appear that either the water or CO_2 coal slurry pipelines are reasonable coal transportation alternatives for meeting LCRA's projected power demands.

By this process of elimination, natural gas, western coal, and local lignite were determined to be the three options available for further consideration. These three options were evaluated based on capital costs, fuel costs, operation and maintenance costs, and overall production costs. The resulting comparison (Tables 2-1 and 2-2 and Figures 2-2 and 2-3) demonstrated that, in every case, a plant fired by local lignite would be the most economical alternative. Based on these economic considerations, LCRA selected the lignite fired electric generation option using Cummins Creek lignite as their preferred energy source alternative.

2.3 ALTERNATIVE SITING AND OPERATIONAL OPTIONS

Lignite resources in addition to the Cummins Creek site are held by LCRA in Bastrop, Fayette, Lee and Washington Counties. Table 2-3 summarizes the quantity and quality of reserves held by LCRA in Bastrop, Fayette,

TABLE 2-1

FPP #4 ALTERNATIVE GENERATION CAPITAL AND FUEL COAST

Plant Type	Net Capability (MW)	1983 Capital Cost (000)	1983 Average Cost (KW)	Construction Period (Years)	Fuel	1983 Fuel Coast $/KWH	Full Load Heat Rate (Btu/KWH)
Lignite-Fueled Steam	397	$324,000	816	5	Lignite	0.0177	11,318
Western Coal-Fueled Steam	540	$477,000	883	5	Coal	0.0202	10,300
Natural Gas-Fueled Steam	415	$218,000	525	4	Gas	0.0400	9,753
Gas-Fueled Single-Cycle Steam & Gas Turbine	69	$ 14,000	215	1	Gas	0.0500	12,253
Gas Fueled Combined-Cycle Steam & Gas Turbine	278	$ 92,000	331	3	Gas	0.0348	8,492
Oil-Fueled Slow-Speed Diesel Base Load Duty	59	$ 87,000	1480	3	No. 6 Oil	0.0360	9,000
Gas-Fueled Medium-Speed Diesel Peaking Duty	35	$ 21,500	619	1.5	Gas	0.0394	9,838
Refuse-Fueled Steam	27	$ 88,000	3259	3	Solid Waste	0.0145*	18,237

Note: Plant variable operation and maintenance cost less tipping fee

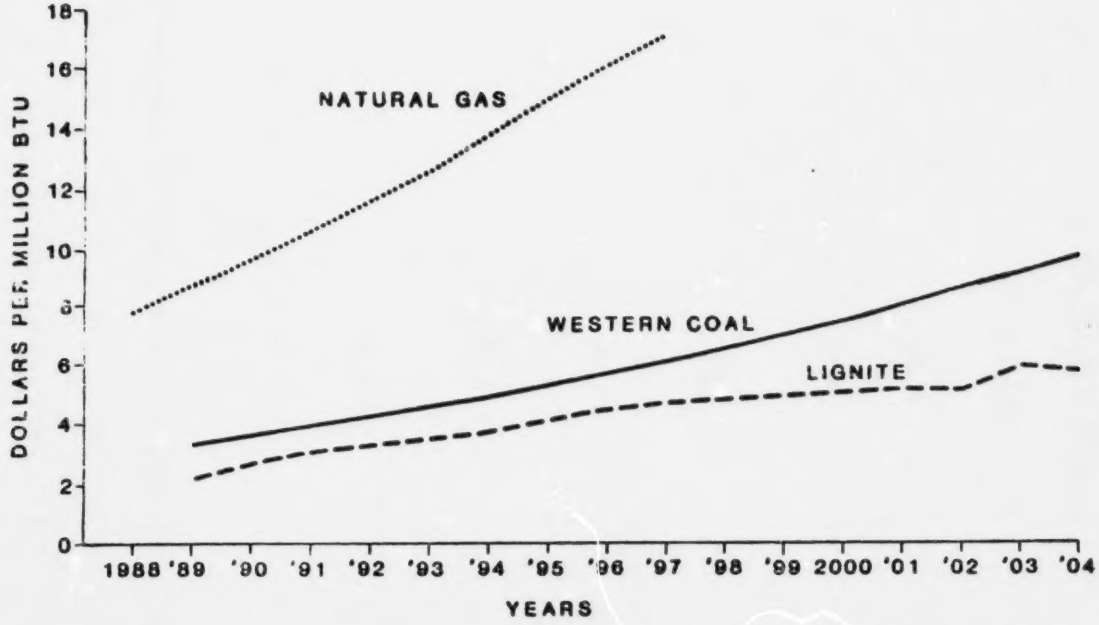
TABLE 2-2

FPP #4 ALTERNATIVE GENERATION OPERATING AND MAINTENANCE COSTS

Plant Type	Fixed Operating and Maintenance Charge (Dollars per KW)	Variable Operating and Maintenance Charge (Cents per KWH)
Lignite - Fueled Steam	$14.214	0.296
Western Coal-Fueled Steam	13.50	0.25
Natural Gas-Fueled Steam	4.20	0.05
Gas-Fueled Single-Cycle Gas Turbine	Nil	0.65
Gas-Fueled Combined-Cycle Steam & Gas Turbine	5.00	0.45
Oil-Fueled Slow-Speed Diesel Baseload Duty	4.25	0.225
Gas-Fueled Medium-Speed Diesel Peaking Duty	3.00	0.225
Refuse-Fueled Steam	123.41	1.445*

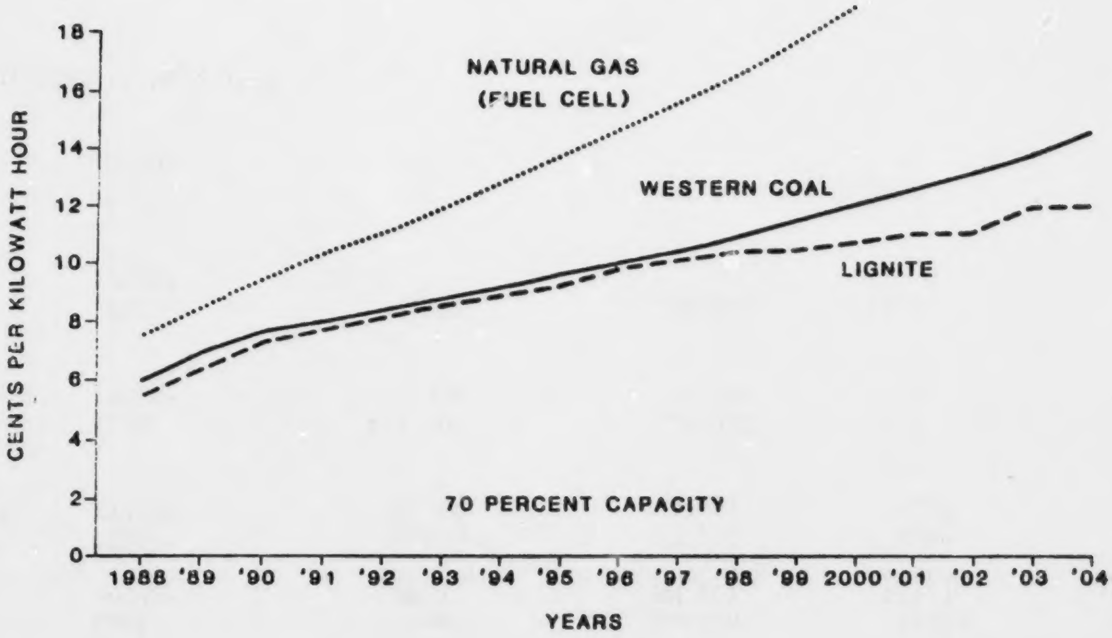
*Note: Plant O & M cost less tipping fee paid by waste collectors to plant.

Figure 2-2
PROJECTED FUEL COSTS FOR UNIT 3



Source: LCRA, 1984a

Figure 2-3
PROJECTED COSTS OF PRODUCING ELECTRICITY FROM UNIT 3



Source: LCRA,1984a

TABLE 2-3

LIGNITE LEASES CONTROLLED BY LCRA

Reserve Area	Lease Holder	In-Place Lignite Tons MM T	Burden MM BCY	In-Place Ratio BCY:To	Average Quality (Btu/Lb.)
Fayette County (Rabbs Creek Area)	LCRA	90.833	777.94	8.56	4,180
	EXXON*	78.354	647.01	8.26	4,180
Fayette County (Cummins Creek Area)	LCRA	124.907	961.900	7.7	4,653
	EXXON*	1.376	10.500	7.6	4,653
Washington County	LCRA	14.772	194.436	13.2	4,838
	EXXON*	-	-	-	-
Bastrop County	LCRA	8.7	287.47	8.4	6,017
	EXXON*	-	-	-	-

*Note: Purchase by LCRA in May, 1983

and Washington Counties (Lee County is omitted because LCRA holds less than 200 acres of reserves there).

The projected amount of lignite needed to supply the two proposed 400 MW units for 37 years is between 200 and 250 million tons, depending on the quality of the lignite. The Cummins Creek area and Rabbs Creek area (Table 2-3) contain 250 million tons and 137 million tons, respectively, of lignite reserves. Also, the lignite in the Rabbs Creek area (4,000 surface acres) has a lower heating value at a higher stripping ratio than the lignite in the Cummins Creek area (12,000 surface acres). This means that the quality is lower and there is more material to excavate in the mining process.

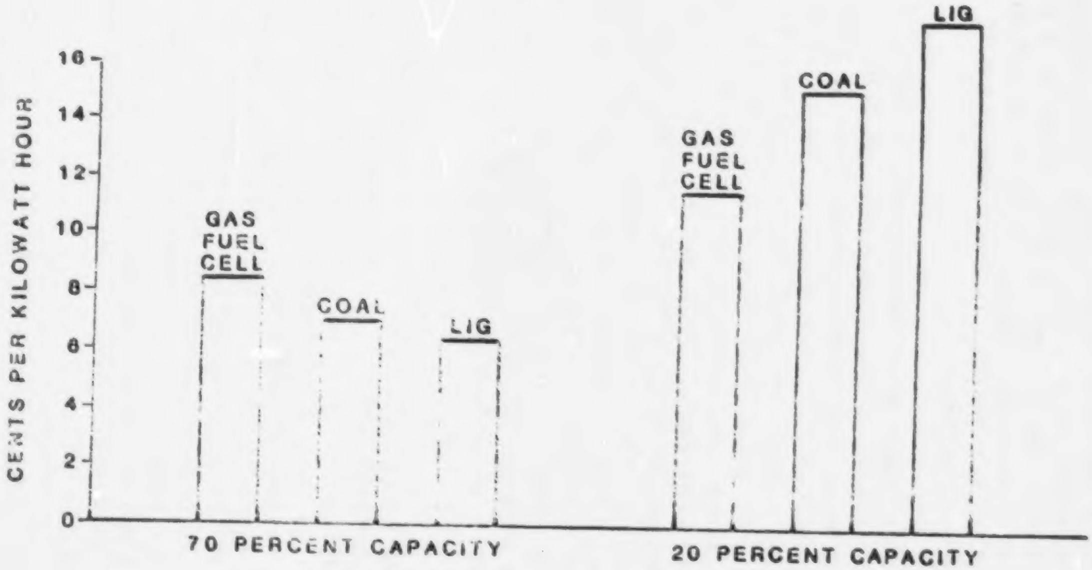
The fact that the Rabbs Creek area contains only a 137 million ton reserve means that mining it as the sole source of fuel is not feasible. However, it is feasible to mine Cummins Creek alone or portions of Cummins Creek and Rabbs Creek in combination. One advantage of using both mine areas would be that the total depth to be mined could be reduced. But using both areas would also greatly increase the project's adverse impacts on natural and socioeconomic resources. These would include the additional residents, roads and highways, rivers and streams, and wildlife habitats potentially affected. According to LCRA (1984a), "the decision to develop the lignite resources in the Cummins Creek area of Fayette County was based on lease control, lignite quantity, and lignite quality. In the Cummins Creek area, LCRA controls a large enough block of land, with sufficient reserves, to supply the fuel needs of two 400 MW generating units. This area also contains the reserves most amenable to surface mining with minimal environmental impacts."

Recognizing the need to add 400 MW of lignite-fired generating capacity to the LCRA system by 1989 (Unit 3), LCRA compared project costs of operating several different types of units at reduced levels. Figure 2-4 shows that the average cost of production for the alternative plants is strongly dependent on how the plant will be used. For base loadings at a 70 percent capacity factor -- LCRA's immediate generation need -- the lignite plant is the most economical. Conversely, at a low annual capacity factor of 20 percent, which may be associated with a cycling unit used only during peak demand periods, it is possible for a less capital intensive plant to become economically feasible. At intermediate loading levels, it is possible that a coal-fired plant would prove to be the most economical.

A similar assessment was made for Unit 4. Figure 2-5 compares the cost of energy for lignite (Unit 4), coal, natural gas-fueled combined-cycle steam and gas turbine, and natural gas-fueled single-cycle gas turbine at various load factors. Lignite is the most cost effective alternative when the unit is operated at 45 percent or greater of its rate capacity.

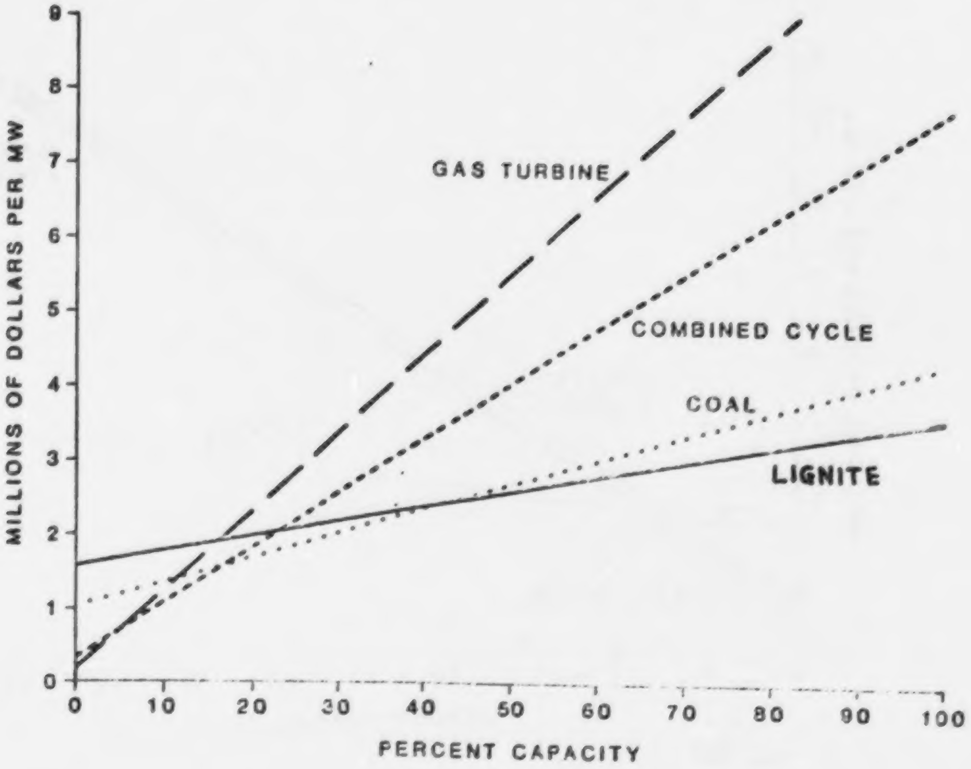
Figure 2-6 compares the cost of energy for lignite (Unit 4), natural gas-fueled steam, oil-fueled slow speed diesel (base load) at various load factors. Lignite is the most cost effective alternative when the unit is operated at 20 percent or greater of its rated capacity.

Figure 2-4
NEW PLANT PRODUCTION COSTS (1989)



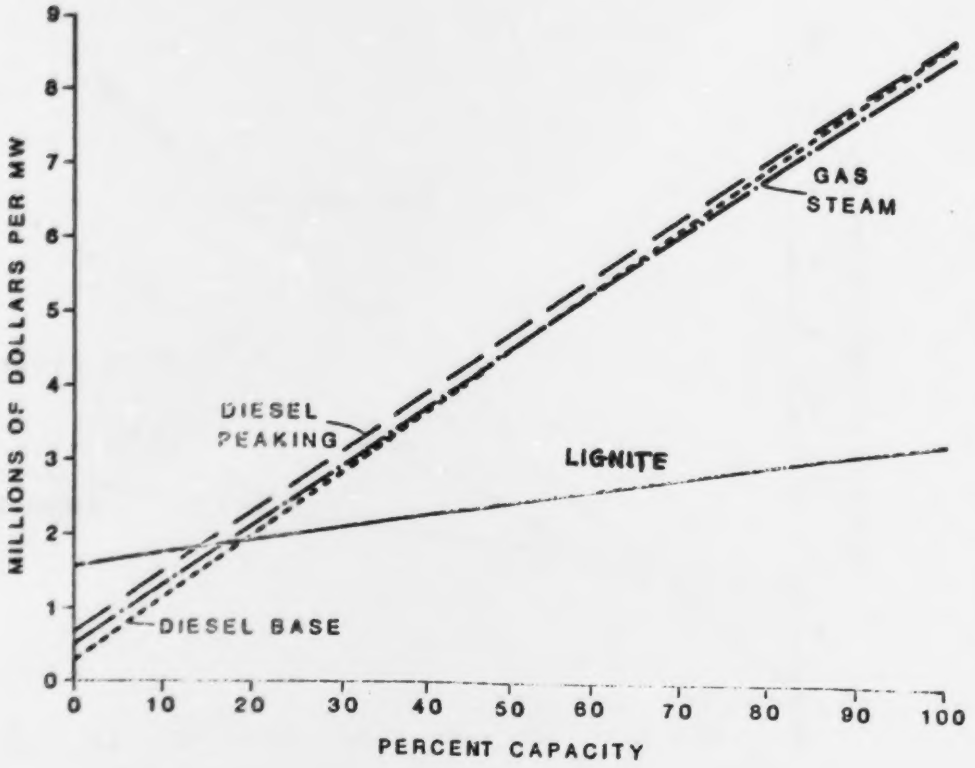
Source: LCRA, 1984a

Figure 2-5
PROJECT BUSBAR COMPARISON (UNIT 4)
Present Value at 10 Percent



Source: LCRA, 1984a

Figure 2-6
PROJECT BUSBAR COMPARISON (UNIT 4)
Present Value at 10 Percent



Source: LCRA, 1984a

Two lignite units were thus considered by LCRA to be the most cost effective alternative for adding 800 MW of base load generating capacity to the system.

An operational alternative which was considered involves power load management. This could be accomplished by reducing load levels and modifying load shapes by either direct intervention by the utility company or by economic incentives made available to the individual customers. Since LCRA does not have control over the ultimate consumers of its power (over 80 percent of its total system sales are wholesale), LCRA can implement such a program only to a limited extent.

2.4 ALTERNATIVE MINING METHODS

Underground mining, auger mining, and surface mining are the three mining technologies which can be used for lignite extraction. The extreme limitations imposed by engineering, environmental, safety, and economic factors rule out the feasibility of the first two techniques. All lignite presently mined in the United States is surface mined and that is the technique proposed for LCRA's Cummins Creek mine.

2.5 ALTERNATIVE TRANSPORTATION SYSTEMS

The Cummins Creek surface lignite mine has been proposed for an area about twelve miles from the existing Fayette Power Plant. Therefore, a means of transporting the lignite from the mining area to the power plant would be required. LCRA considered five types of systems for transporting the projected supply of 6.4 million tons of lignite per year to the power plant. These methods were overland conveyor, trucks, commercial trains (including private railroad) and a slurry pipeline.

A pipeline system handling coal slurry fuels, intended for use in the liquid form, was eliminated from consideration as a technology incompatible with both the specific properties of the lignite and the boiler design. A slurry pipeline system requiring dewatering was also considered to be unattractive because of the immense water requirements, the lack of a slurry system design and operating experience for lignite, and the cost for such a short slurry system (approximately $4.50 per ton).

Four detailed evaluation reports were prepared on the remaining four alternative transportation systems, three by Morrison and Knudsen (MK) and one by Espey, Huston and Associates, Inc. (EH&A). All four reports concluded that the overland conveyor, proposed by LCRA, was the preferable transportation method. LCRA's assessment of the four alternatives for each of the eleven environmental disciplines considered is presented in Table 2-4 and summarized below.

2.5.1 Overland Conveyor (Curved)

The proposed Curved Overland Conveyor system would require about 12 miles of rights-of-way and would be 48 inches wide, approximately five and a half feet high. A 55-foot wide right-of-way would be fenced along its entire length (a 100-120 ft. construction right-of-way would

TABLE 2-4
CUMMINS CREEK PROJECT
RANKING OF ALTERNATIVE TRANSPORTATION METHODS BY ENVIRONMENTAL DISCIPLINE[a]

	Transportation Method				
Environmental Discipline	Curved Conveyor	Overland Conveyor	Truck Haul	Commercial Railroad	Private Railroad
Surface Water Resources	1	1	2	2	2
Ground Water Resources	2	3	1	4	4
Geology	1	1	1	1	1
Soils	1	1	3	2	3
Air Quality	1	2	5	4	2[b] 3[c]
Noise	1	1	5	3	2[b] 4[c]
Ecology	1	2	4	2	3
Land Use	3	3	4	1	2
Socioeconomics	3	3	1	2	2
Cultural Resources	3	3	4	1	2
TOTAL	17	20	30	22	23[b] 26[c]

---

[a] A low number (e.g., "1") indicates a lower level of environmental impact.
[b] Ranking for electric locomotive.
[c] Ranking for diesel locomotive.

be required) with a seven foot high chain-link security fence. It would be designed to operate from 16 to 20 hours per day for 250 days a year, carrying 1,800 tons per hour. Overhead lighting will be provided as necessary for maintenance purposes. The conveyor would be totally enclosed along segments crossing over bodies of water. These cross-overs, as well as any others required by the topography, would be built on truss structures. A permanent maintenance road would be located within the conveyor right-of-way. The conveyor would cross under all state roads and would either tunnel under or pass over county roads. Private roads would be relocated as necessary to maintain access.

Because the conveyor would cross over drainages and would require less surface disturbance than other systems, the potential for erosion and increased sedimentation in streams is lower than for the other systems. For similar reasons, the effects on soils would also be the lowest. The potential for ground water degradation due to accidental lignite spills is also the lowest for this system. Insignificant air emissions rates are expected from the overland conveyor and noise levels were ranked lowest due to its non-intermittent operational sound levels and the potential for mitigation. The overland conveyor system was also judged by LCRA to be preferable for reasons related to overall ecological acceptability. From the standpoints of vegetation and wildlife, the conveyor would affect the least amount of habitat.

The conveyor system would have adverse impacts in the category of land use (in terms of numbers of people affected) because of its lack of alignment flexibility. This will have impacts on access to agricultural and residential areas, and the persistence of view will have a degrading effect on the overall aesthetic value of the area. In terms of socioeconomic impacts, construction of the curved overland conveyor would provide some economic benefit for the project area, but the low maintenance of the transportation system reduces the benefit it would provide. Impacts to cultural resources would include direct effects to any sites located along the route and indirect effects related to visibility and noise with regard to sites located near the proposed alignment.

2.5.2 On-Highway Truck Haul

The on-highway truck haul alternative would require the use of between 14 and 28 miles of public road. Over 900 truck trips for 250 haulage days per year would be necessary to transport the projected load of 6.4 million tons of lignite per year. The existing roadways would have to be upgraded to a 24-foot surface width, with a six foot shoulder width and a total right-of-way of 120 feet. All of these roads would be paved and would require regular maintenance.

This alternative was projected to cause the highest degree of impacts on surface water resources because of the potential for sedimentation problems due to construction-induced erosion and particulate emissions occurring during transport. This alternative was also ranked highest for projected air emission and noise levels. In addition, the high number of truck trips per day would create adverse impacts on public transportation and would create the potential for accidents. The overall ecological impacts are high due to the relatively wide right-of-way requirements, the number of trips per day, the barrier to wildlife movement which would be created, the potential for accidental spills, the associated dust and fugitive emissions, and increased noise levels. This alternative could provide some increased employment opportunities (e.g., truck drivers).

2.5.3 Commercial Railroad

The alternative of using an existing commercial railroad for the transport of lignite to the power project would require the construction of a spur connecting to the Southern Pacific railroad main line in the vicinity of Ledbetter, Texas. This would require the construction of 2.5 to 8.0 miles of spur track, depending on load-out location, and the reestablishment of sections of the Southern Pacific mainline, which has been abandoned and removed from portions of its right-of-way in the Ledbetter area. The trains would run northward from the mine to the Southern Pacific tracks, then westward to Giddings, Texas, on the Southern Pacific line. From Giddings, the trains would travel southward on Southern Pacific track to West Point, Texas. At West Point, the lignite train would transfer to Missouri-Kansas-Texas Railroad trackage and move eastward to the power project. The total one-way distance would be approximately 50 to 56 miles from the train load-out location.

With a requirement of 6.4 million tons of lignite per year, the use of the commercial railroad alternative would probably require 256 cars per day (each car of 100-ton nominal capacity). The number of diesel locomotives required would be dependent on the number of cars used per trip and the number of round trips per day.

Construction of a railroad spur would require a 100-foot wide right-of-way. The right-of-way for the spur would be fenced with standard livestock fencing, approximately 4 feet in height. Farm-to-market and county roads would be crossed at-grade. It is likely that a grade-separated crossing would be required for Highway 290 near Ledbetter.

Because this system would largely utilize existing rail facilities, it would potentially have fewer construction related impacts associated with ecology, surface water resources, and soils when compared to the private railroad and truck haul alternatives. However, the commercial railroad spur would cross Cummins Creek, thereby significantly increasing the potential for adverse surface water impacts. Although this alternative would require a 100-foot wide right-of-way, it would require the shortest right-of-way length of the alternatives. The potential for accidental spills which could cause ground water contamination is high. Adverse impacts from soil disturbance and erosion could also occur as a result of the cut-and-fill operations required by railroad construction.

2.5.4 Private Railroad

The private railroad alternative would necessitate the construction of a rail line within a privately owned right-of-way from the mine to the power project. A private railroad originating from the southern side of the mine would require a main line tract length of between 12 and 14 miles, depending on the final route. Loading and unloading loops would be located at the ends of the main line tract.

The private railroad would require a 100-foot wide right-of-way which would be fenced with standard livestock fencing approximately 4 feet in height. Roads would be crossed at-grade.

Coal cars would be 100-ton capacity, bottom-dump, rapid-discharge cars. The private railroad would operate 16 to 20 hours per day, for 250 days per year, with 4 trips per day.

In performing the environmental assessment, both diesel and electric locomotives were considered. The electric option was favored by LCRA over the diesel option because of lower projected air emissions and lower intermittent noise levels.

Whether diesel or electric, the private rail system was considered to have approximately twice the level of impacts on surface water and 2 1/2 times the level of impacts upon soils than the conveyor due to the requirements for cut-and-fill operations and because culverts would be required at drainage crossings. A diesel railroad was considered slightly less favorable than an electric railroad because of the additional potential for contamination of surface waters due to fuel spills and emissions. Both systems would have the potential for accidental lignite spills. Since the private rail system would have a shorter route, it was given a slightly lower impact rating than commercial rail. Overall ecological impacts from either of the two private rail options would be similar to the commercial rail option, except that more new right-of-way would be required.

The amount of right-of-way required would also incur a higher degree of cultural and land use impacts. The private electric rail is ranked as less disruptive than the private diesel rail primarily due to a lower amount of pollutant runoff expected along the right-of-way.

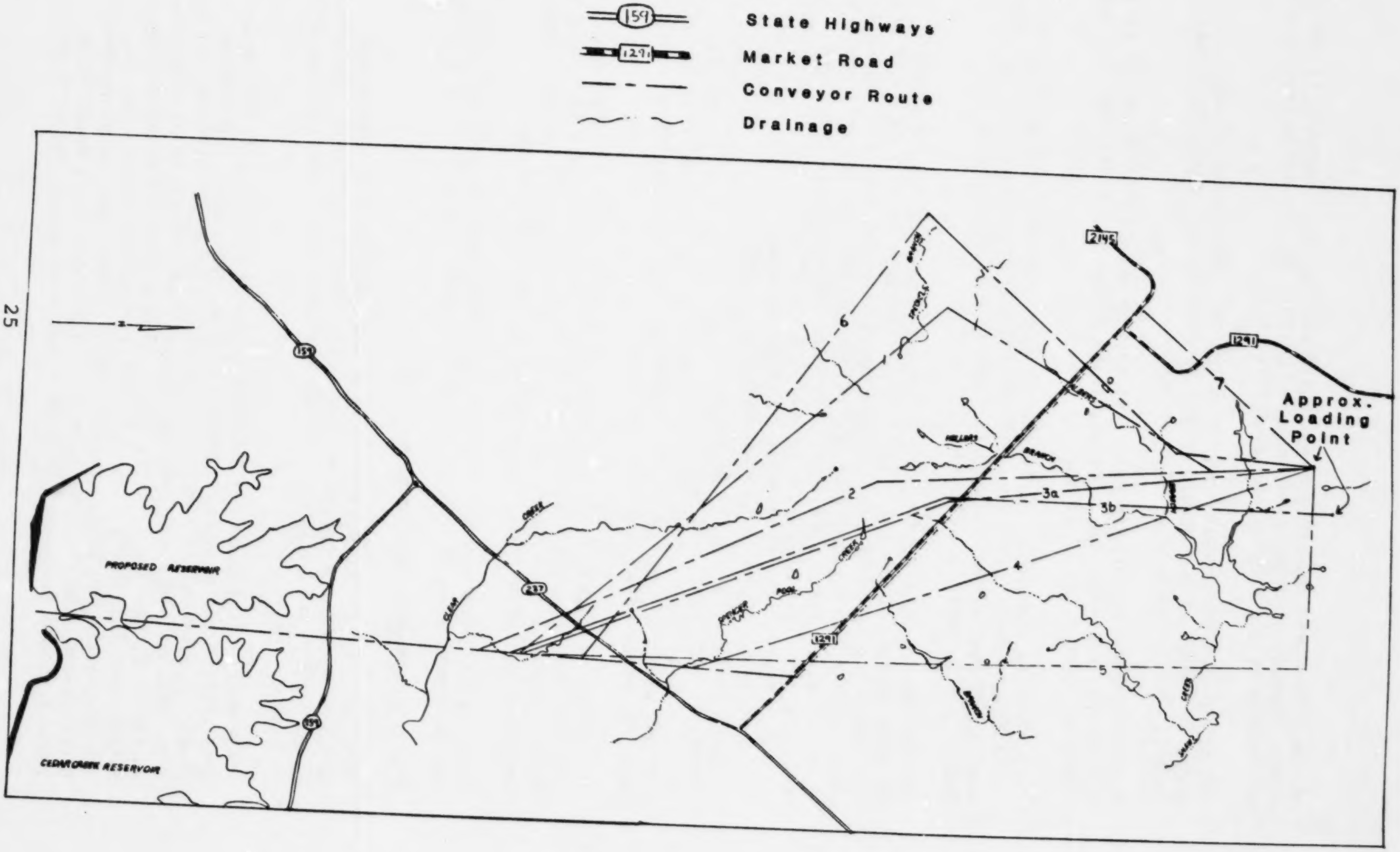
After considering economic and environmental factors, LCRA selected the overland conveyor as the preferred lignite transportation system.

2.6 ALTERNATIVE TRANSPORTATION ROUTES

Once the overland conveyor method of transporting the lignite was selected by LCRA, alternative routes for the conveyor were considered. Espey, Huston and Associates (EH&A) evaluated eight corridors as shown in Figure 2-7a.

These eight alternative routes were selected from an infinite number of potential routes by using a procedure that considered engineering, financial, and environmental constraints. The eight alternatives selected from detailed human and computer analysis were numbered as alternatives Routes 1, 2, 3a, 3b, 4, 5, 6, and 7. The conclusion drawn by Espey, Huston, and Associates, Inc. was that conveyor Routes 2, 3a, 3b, and 4 are essentially equal in terms of impact values and are environmentally preferable to Routes 1, 5, 6, and 7. LCRA then chose Route 3b as their proposed alignment, because it was more compatible with the mine

FIGURE 2-7a CONVEYOR CORRIDOR MAP


LEGEND
159 State Highways
1291 Market Road
Conveyor Route
Drainage
Approx. Loading Point
2
3a
3b
4
5
6
7
159
237
1291
2145
PROPOSED RESERVOIR
CEDAR CREEK RESERVOIR
CLEAR CREEK
SPRINGS
BRANCH
HILLIARD BRANCH
CREEK
POOL
N

design. That alignment has since been slightly modified to accommodate the use of a curved overland conveyor design. The curved conveyor system eliminates the the transfer stations by utilizing a continuous belt line and designing large radium curves to achieve necessary changes of direction as shown in Figure 2-7b.

In the detailed analyses, 46 environmental criteria (Table 2-5) were evaluated and numerically weighted for each of the proposed alignments. The objective in weighting the criteria was to determine which criteria had the highest and lowest relative degrees of impacts. A conveyor route could then be selected which would follow features of low sensitivity and avoid areas generally agreed to be highly susceptible to impact.

Although the results (Table 2-6) showed many slight differences among the routes, several of the environmental criteria appeared to have the most influence on the final environmental ranking. Those criteria include overall route length; number of residences, nonresidential structures, and private roads likely to be impacted; the amount of bottomland/riparian forest and wetland areas to be impacted; visibility from public access areas such as state highways and county roads; and potential impacts on areas of high archaeological/historical value.

A comparative discussion focusing on the most significant criteria, extracted from the 1983 EHA report and supplements to the report, is presented below:

Alternative Route 1

Alternative Route 1 is the next to the longest of the alternatives (approximately 13.2 miles). This route would impact the fewest number of residences and next to the lowest number of nonresidential structures and private roads. Route 1 would impact the greatest amount of bottomland/riparian forest and next to the largest amount of wetlands. This route would have a relatively low visibility from state highways and a fairly high visibility from county roads.

Alternative Route 2

Alternative Route 2 is only slightly longer than Routes 3a and 4, with a total length of 12 miles. Route 2 would impact fewer residences than Routes 3a or 4. Alternative Route 2 would impact slightly more bottomland/riparian forest and wetland areas than Routes 3a or 4. This route would have the highest visibility from state highways, but a relatively low visibility from county roads. Route 2 would cross the least number of private roads of any of the alternatives, and along with Route 4, would cross within 300 feet of the fewest recorded or observed historical sites or structures, but within 200 feet of Waldeck Cemetery.

Alternative Route 3a

Alternative Route 3a is approximately 11.9 miles in length, and along with Route 4, is the shortest of the alternatives. Route 3a would impact more residences and non-residential structures than most of the other alternatives, but would impact relatively less bottomland/riparian forest and wetland areas than most of the other alternatives. Route

Figure 2-7b

CUMMINS CREEK PROJECT
STRAIGHT/CURVED CONVEYOR COMPARISON

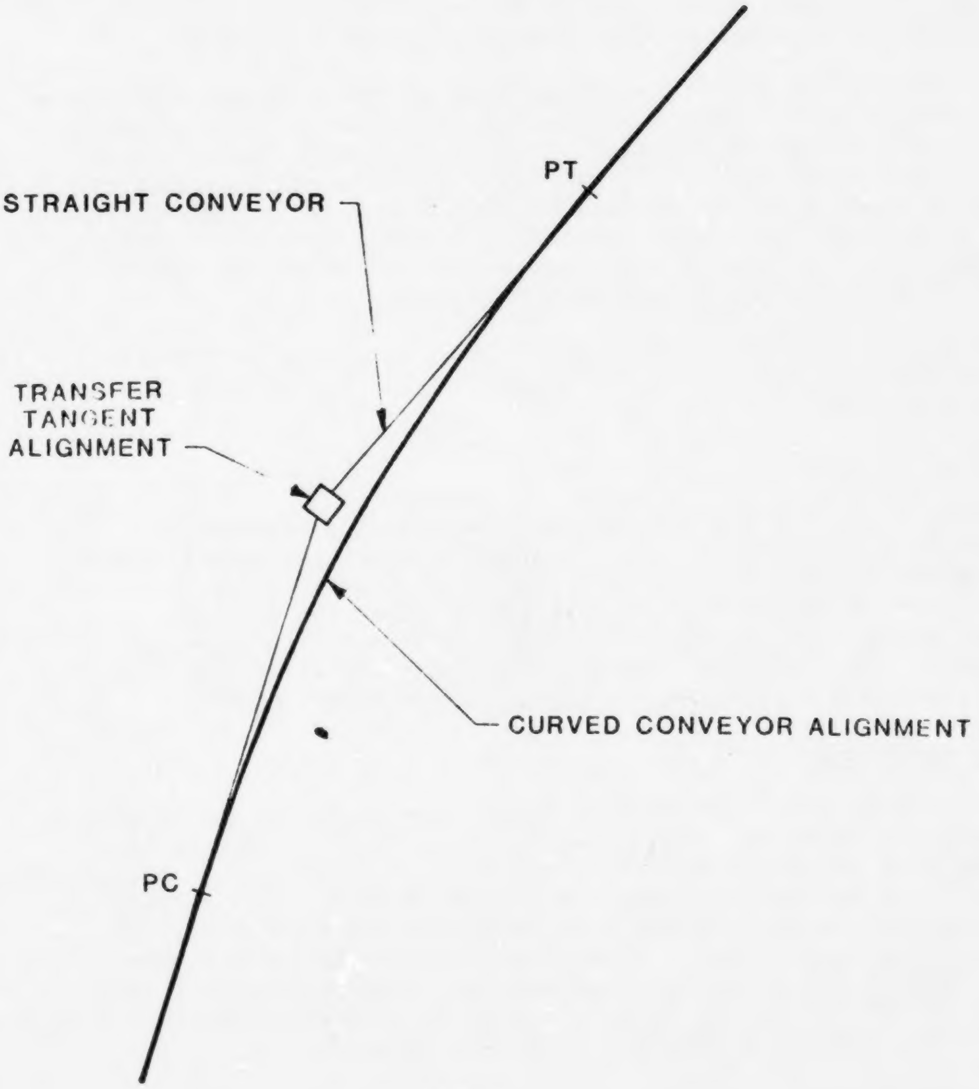

PT
STRAIGHT CONVEYOR
TRANSFER
TANGENT
ALIGNMENT
CURVED CONVEYOR ALIGNMENT
PC

TABLE 2-5

LIGNITE CONVEYOR
ALTERNATIVE ROUTE EVALUATION
ENVIRONMENTAL CRITERIA

1 Length of ROW (100' segments)
2 Length of ROW through private lands (100' segments)
3 Length of ROW through public lands (100' segments)
4 Number of residential and commercial structures (within 300') to be removed by ROW
5 Number of residential and commercial structures within 300'-500' of ROW
6 Number of residential and commercial structures within 500-1,000' of ROW
7 Number of non-residential structures (within 100') to be removed by ROW
8 Length of ROW through cropland (100' segments)
9 Length of ROW through pastureland/grazingland (100' segments)
10 Length of ROW through upland forest (woodland) (100' segments)
11 Length of ROW through bottomland/riparian forest (woodland) (100' segments)
12 Length of ROW through industrial areas (100' segments)
13 Length of ROW with slope 10 - 25% (100' segments)
14 Length of ROW with slope >25% (100' segments)
15 Length of ROW along or parallel to ridgetops (100' segments)
16 Length of ROW through wetlands (100' segments)
17 Length of ROW across water (streams, ponds) (100' segments)
18 Length of ROW across prime soils (100' segments)
19 Length of ROW adjacent to transmission lines (100' segments)
20 Length of ROW adjacent to pipelines (100' segments)
21 Length of ROW adjacent to railroads (100' segments)
22 Length of state highway from which the ROW is visible (100' segments)
23 Length of county roads from which the ROW is visible (100' segments)
24 Length of ROW visible from recreational or resort areas (100' segments)
25 Length through recreational areas (including National or state parks or reserves) (100' segments)
26 Length of ROW visible from commercial areas (100' segments)
27 Length of ROW visible from institutional areas (100' segments) (including cemeteries, schools, churches)
28 Number of pipeline crossings
29 Number of transmission line crossings
30 Number of U.S. highway crossings
31 Number of state highway crossings (including farm-and ranch-to-market roads)
32 Number of country road crossings
33 Number of private road crossings (including private driveway and oil well access roads)
34 Number of railroad crossings
35 Number of stream crossings
36 Length of ROW parallel (within 100') to streams (100' segments)
37 Number of fences crossed
38 Number of property lines crossed
39 Length of ROW parallel (within 100') to property lines

TABLE 2-5
(concluded)

40 Number of receptors sensitive to noise within 500'
41 Number of transfer stations required
42 Number of recorded or observed historic and prehistoric sites or cemeteries crossed (within 300')
43 Number of recorded or observed historic sites or cemeteries within 300-1,000' of ROW
44 Number of National Register listed or determined eligible sites crossed
45 Number of National Register listed or determined eligible sites within 1000' of ROW
46 Length of ROW through areas of high archaeological/historical site potential (100' segments)

TABLE 2.6

RESULTS OF ENVIRONMENTAL EVALUATION OF ALTERNATIVE CONVEYOR ROUTES

	Alternative Routes							
Criterion[a]	1	2	3a	3b	4	5	6	7
1	696	632	630	639.5	630	705	776	707
2	696	632	630	639.5	630	705	776	707
3	0	0	0	0	0	0	0	0
4	4	7	8	7	8	9	6	7[b]
5	7	5	9	8	4	6	6	8
6	14	16	18	18	24	18	22	19
7	7	9	12	9	6	17	6	3
8	62.4	76.8	52.9	77.3	56.5	90.3	68	58.3
9	462.4	429.5	442.1	458.5	435.5	494.8	570.6	530.7
10	81.2	64.7	76.7	42.7	78.3	51.1	59	48.5
11	46.2	19.1	14.0	19.3	17.6	11.6	44.4	14.6
12	25.4	30.1	26.4	23.4	27.5	23.7	26.8	26.1
13	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0
15	17	22	9	12	5	13	7	0
16	6	2	1	0	0	10	3.4	12.1
17	19.3	14.8	20.8	18.2	14.6	25.5	17.3	16.7
18	187.8	301.6	226.8	227.5	262.0	324.4	200.8	288.0
19	197	197	197	197	197	197	197	197
20	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0
22	79.2	105.6	58.1	58.1	100.3	100.3	79.2	337.9
23	92.4	84.5	84.5	95.0	73.9	147.8	142.6	79.0
24	0	0	0	0	0	0	0	34.4 (arena)
25	0	0	0	0	0	0	0	250

TABLE 2-6
(Concluded)

	Alternative Route							
Criterion[a]	1	2	3a	3b	4	5	6	7
26	0	0	0	0	45	45	45	45
27	0	0.5	0	0	0	0	0	34.4 (church)
28	3	3	3	3	3	3	3	3
29	3	3	3	3	3	3	3	3
30	0	0	0	0	0	0	0	0
31	3	3	3	3	3	3	3	3
32	7	7	7	7	6	9	8	6
33	12	11	17	14	14	20	9	21
34	0	0	0	0	0	0	0	0
35	14	6	10	8	10	11	14	10
36	34	2	18	24	20	28	20	12.5
37	102	86	90	90	82	94	92	68
38	54	54	49	50	48	42	59	30[c]
39	6.9	0	0	0	0	0	5.2	2.94[d]
40	0	0	0	0	0	0	0	1 (church)
41	3	2	2	2	2	2	4	2
42	7	6	10	11	6	8	5	11
43	20	26	19	22	20	20	23	24
44	0	0	0	0	0	0	0	0
45	0	0	0	0	0	0	0	0
46	96	82	54	97	95	112	126	111

---

[a] Waldeck Church and Waldeck Arena are included within this criterion; both are within 300 feet of the centerline.

[c] Includes only property lines from mine loading point to crossing of Highway 237.

[d] Within 150 feet instead of 100 feet because route is within approximately 150 feet of FM 1291 right-of-way.

3a would be less visible from state highways than any of the other alternatives (except for Route 3b, which would have an equal visibility from state highways) and would also have a fairly low visibility from county roads. The route would cross a comparatively high number of private roads. Alternative Route 3a would cross within 300 feet of a relatively high number of observed or recorded historical sites or structures when compared to the other alternatives, and within 300 feet of Waldeck Cemetery. However, this route would impact the least amount of area with high archaeological/historical site potential.

Alternative Route 3b

Alternative Route 3b ranks fourth in terms of overall length (12.1 miles), although it is only 0.1 mile longer than Alternative Route 2 and 0.2 mile longer than Alternative Routes 3a and 4. This alternative would impact a relatively average number of residences and nonresidential structures. The combined total of bottomland/riparian and wetland areas that would be affected by Alternative Route 3b is relatively low. Route 3b has the lowest visibility (along with Route 3a), from state highways, and fairly high visibility from county roads. This alternative would pass within 300 feet of a high number of observed or recorded historical sites or structures.

Alternative Route 4

As mentioned above, Alternative Routes 3a and 4 are the shortest routes and would therefore impact the least acreage. Alternative Route 4 would impact the same total number of residences as Route 3a, as well as one commercial operation ("237 Cafe"), but the fewest nonresidential structures would be affected by this Route. This route would impact slightly more bottomland/riparian forest than Route 3a, but would not impact any wetlands. Route 4 would have a relatively high visibility from state highways, but the lowest visibility from county roads of any of the alternatives. This route would cross within 300 feet of the fewest (along with Route 2) observed or recorded historical sites or structures of any of the alternatives, but would pass through more areas with high archaeological/historical site potential than Route 3a.

Alternative Route 5

Alternative Route 5 is the longest of the alternatives, being about 13.4 miles in length. This route would likely require the removal of the most residences, it would be within 300-500 feet of the "237 Cafe," and would impact the highest number of nonresidential structures and private roads. Alternative Route 5 would impact the least amount of bottomland/riparian forest, but the largest amount of wetland areas. This route would be highly visible from state highways and have the highest visibility from county roads of any of the alternatives. Although Route 5 does not rank high in terms of impacts to observed or recorded historical sites or structures, that route would pass through the greatest amount of area with high archaeological/historical site potential.

Alternative Route 6

Alternative Route 6 crosses 13 intermittent streams, one perennial stream, and numerous ponds. These factors, along with the relatively long (200 feet) right-of-way parallel to streams, make this the least favorable route with respect to surface water resources and cause it to rank relatively high with regard to aquatic and terrestrial resources. This route would require a greater total length of right-ofway (14.7 miles) than Alternative Routes 1-5 and would therefore exhibit a higher potential for adverse impacts upon ground water resources. It would also be one of the most damaging to existing vegetation. Of the 23.7 acres of wooded habitat to be cleared during construction, 10.2 acres are bottomland/riparian forest. In addition, 4.9 acres of aquatic habitat and 0.8 acres of wetland would be impacted. This route would also affect more landowners than any other alternative, although it would involve removing a relative low number of residential and non-residential structures. It would also induce relatively low impacts on transportation systems. This route would pass through the greatest amount of area with high archeological/historical site potential. In the overall comparison, this alternative ranks next to last from an environmental standpoint.

Alternative Route 7

Alternative Route 7 entails the second largest right-of-way requirements and the greatest length of state highway from which the right-of-way is visible, since a large portion of this route parallels FM 1291. A relatively high number of residence and non-residential structures would be affected and private road crossings would be the highest for this route. Aesthetic impacts would be highest for this corridor because it would have the greatest length of right-of-way visible from both a recreational area (arena) and a church. By far, the largest impacts upon recreational areas and wetlands would be incurred from this alternative. The impacts to historic sites and areas of high archeological/historical potential would be high in comparison to the other corridor routes.

2.7 ALTERNATIVE MINING TECHNOLOGIES

Surface mining lignite involves several rather distinct types of earth moving processes such as topsoil stripping, overburden removal, and lignite extraction. Of these, overburden removal poses the key questions with regard to the selected technology. High capital investments are required for the overburden removal equipment, while topsoil handling and lignite extraction can be incorporated into any of the overburden removal techniques without independently posing major mining equipment selection problems.

Thus, the initial evaluation of alternative mining technologies centered around six selected alternative methods of removing the overburden. Three of those alternatives (the all-scraper alternative, the truck/shovel option, and the stripping shovel/dragline combination) were eliminated early in the evaluation process because of engineering and geotechnical problems. The three remaining alternative mining technologies which LCRA evaluated in more detail involved the use of bucket wheel excavators, draglines, and a combination of bucket wheel excavators and draglines.

A bucket wheel excavator (BWE) (Figure 2-8) consists of a large rotating wheel on which are mounted a series of buckets. By passing this rotating wheel into the excavation face, a continuous overburden removal process is attained. Because the BWE is continuously moving back and forth, large volumes of material can be removed as long as hard digging zones are not encountered. A mobile transfer conveyor (MTC) is normally used with a BWE to make the link between the BWE and the conveyor systems to extend the operating reach of the BWE system. Material flow is generally from the BWE to MTC and hence to an around-the-pit conveyor. Material flows around the operating mine area to the spoil side where a spreader would be used to reconstruct the original topography behind the operation. According to LCRA, the operational advantages and disadvantages of BWE's are as follows:

Advantages:

- More consistent power consumption; draglines and shovels characteristically have high power consumption peaks and also high power charges to the electrical system.
- BWE pits must be wider to accommodate the conveyor systems; thus pit slopes will be shallower, and thereby safer.
- BWE systems inherently require less rough grading, yielding some savings on reclamation expense. BWE systems can operate to greater depths in a series of benches without rehandling overburden material.
- BWE systems can develop their own ramps with little assistance of mobile equipment.

Disadvantages:

- BWE systems may be more labor intensive than draglines or stripping shovels.
- BWE's are not well suited to digging hard ground.
- The wider pit takes longer to develop than a dragline pit.
- Because of the width of the BWE pit, reclamation follows behind the active pit by several years.

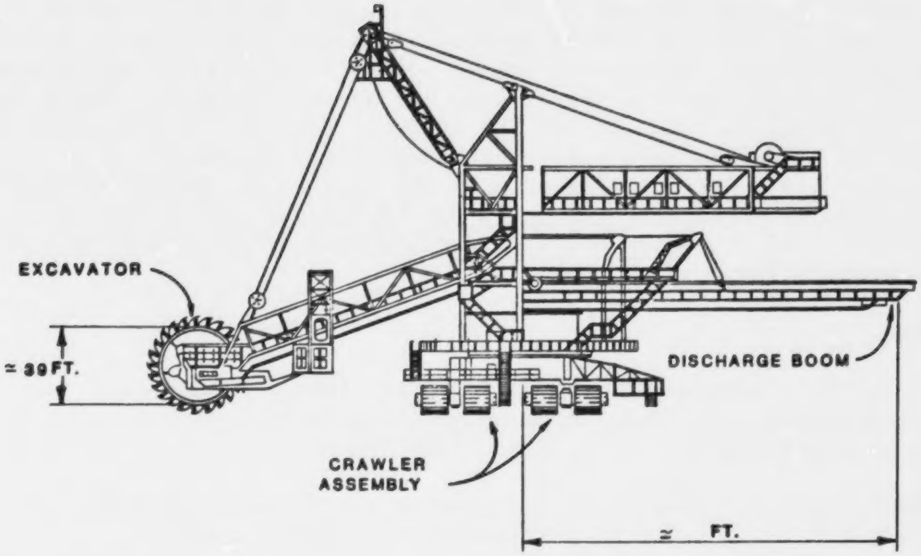
A dragline (Figure 2-9), consists of a large, single bucket suspended from a long (300-400 ft.) boom by cables. It operates by dropping the bucket into and pulling it through the overburden. In filling and emptying the bucket, the dragline excavates material and casts it to an overburden ridge within the radius of the boom.

According to LCRA, the operational advantages and disadvantages of the dragline are as follows:

Advantages:

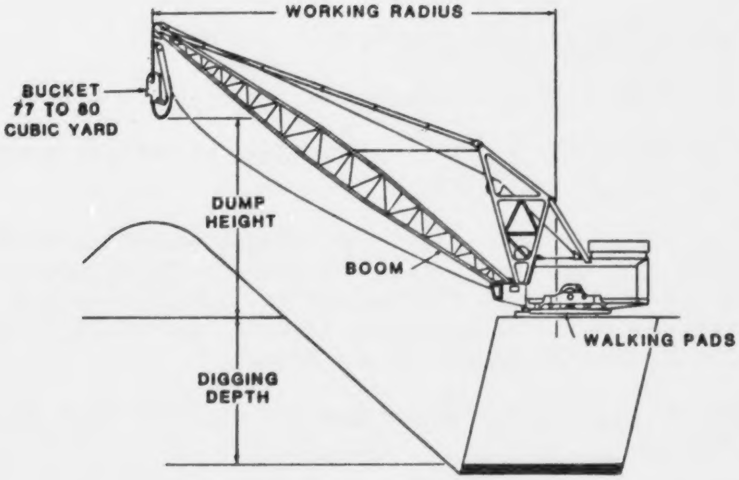
- Not as labor intensive as a BWE.
- Flexibility of operation within a given area.

Figure 2-8


EXCAVATOR
≈ 39 FT.
DISCHARGE BOOM
CRAWLER ASSEMBLY
≈ FT.

TYPICAL BUCKET WHEEL EXCAVATOR

Figure 2-9


WORKING RADIUS
BUCKET 77 TO 80 CUBIC YARD
DUMP HEIGHT
BOOM
WALKING PADS
DIGGING DEPTH

TYPICAL WALKING DRAGLINE DESIGN

- Minimum predevelopment required.
- Pit widths are relatively narrow.
- Direct casting of spoil.

Disadvantages:

- More mobile equipment assistance required than for a BWE.
- Overburden ridges require leveling by auxiliary equipment.
- Selective burden handling may not be as precise as with a BWE.
- Effective depth of operation is approximately 120 feet.
- Greater depths can be mined only with extensive rehandling.

LCRA's preferred alternative mine plan represents an attempt to minimize the limitations of both systems by using a bucket wheel excavation/dragline (BWE/DL) combination. Some of the advantages of this combined approach include maximizing lignite recovery, eliminating much of the overburden rehandling associated with a total dragline operation, increased mining depth, preferable reclamation options, decreased lignite storage requirements, and increased mechanical efficiency.

In comparing the BWE, DL, and BWE/DL alternatives, LCRA concluded that each method would have many similar effects on environmental resources. The main reason for this is that each would mine the same general area (i.e., the selected Cummins Creek Mine). All three methods would result in similar adverse impacts on surface water, vegetation and wildlife. Also, considering the total types and amounts of equipment involved, the impacts on air quality and noise would be comparable. Regarding socioeconomic impacts the BWE-only option is the most labor intensive but considering the many variables for the life-of-mine operation, all three options would have similar secondary effects on local economies and communities.

However, the BWE-only and BWE/DL methods would create the largest mine pits, which would result in a large permanent overburden stockpile, a large end lake, and additional time to complete the reclamation process. These effects constitute additional adverse impacts on land use and land productivity.

Other differences between these options would occur in the areas of geology, groundwater and soils. The BWE-only method has the advantage that material from near surface horizons would remain at or near the surface, while the material from deeper cuts would remain at the lowest level in the pit. The combined BWE/DL method would also have this advantage, while the all-DL method would result in the mixing of deep and shallow horizons at or near the surface, which increases the potential for adverse impacts on soils and reclamation.

Regarding groundwater, the BWE-only and BWE/DL options require localized depressurizing of deeper aquifers to eliminate potential floor heave problems, which would result in adverse impacts on additional groundwater supplies.

The following criteria were utilized to estimate the economic costs of the mining alternatives based on the cost per ton of recovered lignite:

- No acquisition or depletion rate was used
- Prepayment schedules for major excavating equipment based on manufacturers
- Predevelopment schedules based on the requirements of the individual alternatives
- No royalties
- No land rentals
- No profit
- No state, county or local tax
- No investment tax credit
- Labor rates based on the skill level required for operation of the equipment.

Costs are summarized in Table 2-7. Table 2-8 provides a set of economic rating criteria ranging from 0 (minimal impact) to 5 (impact sufficiently high to represent a fatal flaw). Since coal of higher Btu value (8,000-12,000 Btu) can be obtained from western mines for a delivered cost of $30 to $60 per ton, the maximum mining plus delivery cost for (4,000-5,000 Btu) was established at $22 per ton. For this reason, an impact rating of 5 was established at greater than $16 per ton mining cost. A 4 rating was established at $12 to $15.99 per ton; a 3 rating was established at $8 to $11.99 per ton, and so forth.

Based on the cost identified in Table 2-7 and the cost criteria defined in Table 2-8, the various mining alternatives were rated as shown in Table 2-9. As shown, the alternatives which include BWE's are the most favored option from an economic standpoint. The dragline-only system is the most expensive of the group.

2.8 RECLAMATION ALTERNATIVES

The proposed reclamation plan entails the use of topsoil over oxidized overburden as the growth medium on reconstructed surfaces. This choice of materials handling provides for the most similarity to pre-mine conditions.

Alternatives to using regraded topsoil over oxidized overburden include the following: a topsoil-subsoil mix; a random mix (topsoil, subsoil and overburden); and selective overburden strata. Any of these mixtures would be applied to a depth of four feet.

From an operational standpoint, a topsoil-subsoil mix requires scrapers to expose the A and B soil horizons. Upon visual confirmation, the scraping would be stopped when the C horizon is reached. The extracted

TABLE 2-7
CUMMINS CREEK PROJECT
COST PER TON OF EXCAVATED LIGNITE FOR THREE MINING ALTERNATIVES

Technology	Cost Per Excavated Ton of Lignite
Dragline-Only (4-5 draglines required)	$12.00[a]
BWE-Only (4 BWE's required)	$10.75[a] - $11.00
BWE/Dragline (2 BWE's and 2 draglines required)	$10.67[b]

---

[a] approximate costs
[b] M-K Cost Estimate, November 1983

TABLE 2-8
CUMMINS CREEK PROJECT
ECONOMIC IMPACT RATING CRITERIA

Rating	Criteria
0	Mining cost less than $2.00 per ton
1	Mining cost from $2-3.99 per ton
2	Mining cost from $4-7.99 per ton
3	Mining cost from $8-11.99 per ton
4	Mining cost from $12-$15.99 per ton
5	Mining cost greater than $16 per ton

TABLE 2-9
CUMMINS CREEK PROJECT
ECONOMIC IMPACT RATING OF THREE MINING ALTERNATIVES

Alternative	Impact Rating
Dragline-Only	4
BWE-Only	3
BWE/Dragline	3

strata would be mixed and stockpiled until used for revegetation. This materials handling option would most likely result in a four-foot depth of a clayey media since subsoil texture is predominately clay and since subsoils are of greater thickness than the topsoil. This resulting medium should have high water retention and fertility status but would require more intensive management than the existing sandy to loamy topsoils.

The use of random overall mix, including all material to be disturbed (topsoil, subsoil and overburden) would require no selective materials handling. The resultant mix would have heterogeneous chemical and physical characteristics most nearly similar to that of the overburden but possessing some of the fertility and microflora inherent in the topsoil and subsoil. Since some overburden strata have been found to be acidic, scattered "hot spots" could occur on the reclaimed surfaces and would have to be treated on a case-by-case basis. This heterogenous growth medium would require sampling and management in order to assure fertility.

Selective overburden replacement on reclaimed surfaces entails the knowledge by the mine operator in order to selectively remove, store and then replace suitable or desirable overburden. This scenario would also require a pre-mining evaluation and the visual identification of zones of potential unsuitability. Desirable overburden replacement would result in a four-foot mixture of semi-homogeneous overburden material. Since the overburden evaluation has indicated that the most desirable zones are predominately clayey, the resultant mix would be of a heavier texture.

Specific information regarding the exact nature of the land use to which each parcel of the mining area would be returned is not currently available. Although many alternatives are possible, individual landowner preferences will play a large part in this determination. Since these preferences need not be specified until one to two years prior to reclamation, and since this decision is not directly within LCRA's purview, an analysis of the alternatives was not conducted. However, in cases where the landowners do not specify a land use, all lands with the exception of those identified below will be returned to their original land use. The exceptions (overburden stockpile, end lake, selected water control structures) would remain as permanent changes to the existing land use. The projected percentage of mining area in various pre and post mining land use categories is shown on Table 3-3.

2.9 ALTERNATIVE MITIGATION PLANS

Discussions of measures proposed to mitigate certain adverse environmental impacts are included in Chapter 3, "Environmental Consequences of Alternatives on Affected Environment."

2.10 ALTERNATIVES PROPOSED BY LCRA (PROJECT DESCRIPTION)

This section presents a summary of LCRA's selected mining, reclamation, and power production alternatives proposed by LCRA for the Fayette Power Project and Cummins Creek Lignite Mine. Additional information is included in Section 2 of the EID.

2.10.1 Cummins Creek Mine And Curved Overland Conveyor System

The proposed Cummins Creek Project would consist of a surface lignite mine, haul roads, associated support facilities, and 12.1 miles of curved overland conveyor linking the mine with the Fayette Power Project (FPP) near La Grange, Texas. The project location is shown in Figure 2-10.

The project area is located in northern Fayette County south of the town of Ledbetter. It is bounded on the north by U.S. Highway 290 and proceeds southwest crossing FM 1291 to an area west of Waldeck. The total acreage to be disturbed by mining and supporting activities is an estimated 9,708 acres (9,586 in the mine area, 122 in the conveyor area) over a 37-year mining period.

The purpose of the project is to provide an economical fuel source for the production of electricity by LCRA, the project proponent and owner. The mine plan is designed to be capable of supplying sufficient lignite for two new 400 MW power generating units, designated Units 3 and 4. Initial mine operations are proposed to begin in October 1986 with lignite delivery to Unit 3 starting in July 1987 and delivery to Unit 4 starting in October 1990. The average annual production requirement for both units would be approximately 6.4 million tons of lignite. Full mine capacity will be achieved in 1990.

A curved overland conveyor system would transport the lignite from the Cummins Creek Mine to the FPP. An enclosed surge pile intended to provide a constant supply of lignite to the overland conveyor would be located approximately two miles northeast of Waldeck and 4.7 miles southeast of Ledbetter. The overland conveyor corridor would extend in a southeasterly direction to a point east of Oldenburg, thence south to the FPP, a distance of approximately 12 miles. The overland conveyor will cross a portion of the FPP cooling reservoir. At this location, as well as at other water crossings, the conveyor will be totally enclosed.

Construction activities for the mine are proposed to be initiated in 1985, subject to acquisition of relevant permits. Mining operations would develop and recover the lignite within the mine boundary shown in Figures 2-11a and 2-11b. A combination stripping system using both bucket wheel excavators (BWE's) and draglines (DL's) is planned for burden removal. Two BWE's, each with an annual capacity of approximately 20 million bank cubic yards, and two draglines with bucket capacities of 78 bank cubic yards, would be used to remove a majority of the burden. Small volumes of burden would be moved by mobile equipment or dozers. Continuous surface miners (CSM's) are proposed to load most of the lignite into haul trucks for transport to the mine conveyor system. The mine conveyor system would be located within the pit for over 85 percent of the mine life and would transport the lignite to the curved overland conveyor system. Table 2-10 summarizes the projected total production by the major equipment.

Figure 2-10

CUMMINS CREEK PROJECT

FAYETTE COUNTY, TEXAS

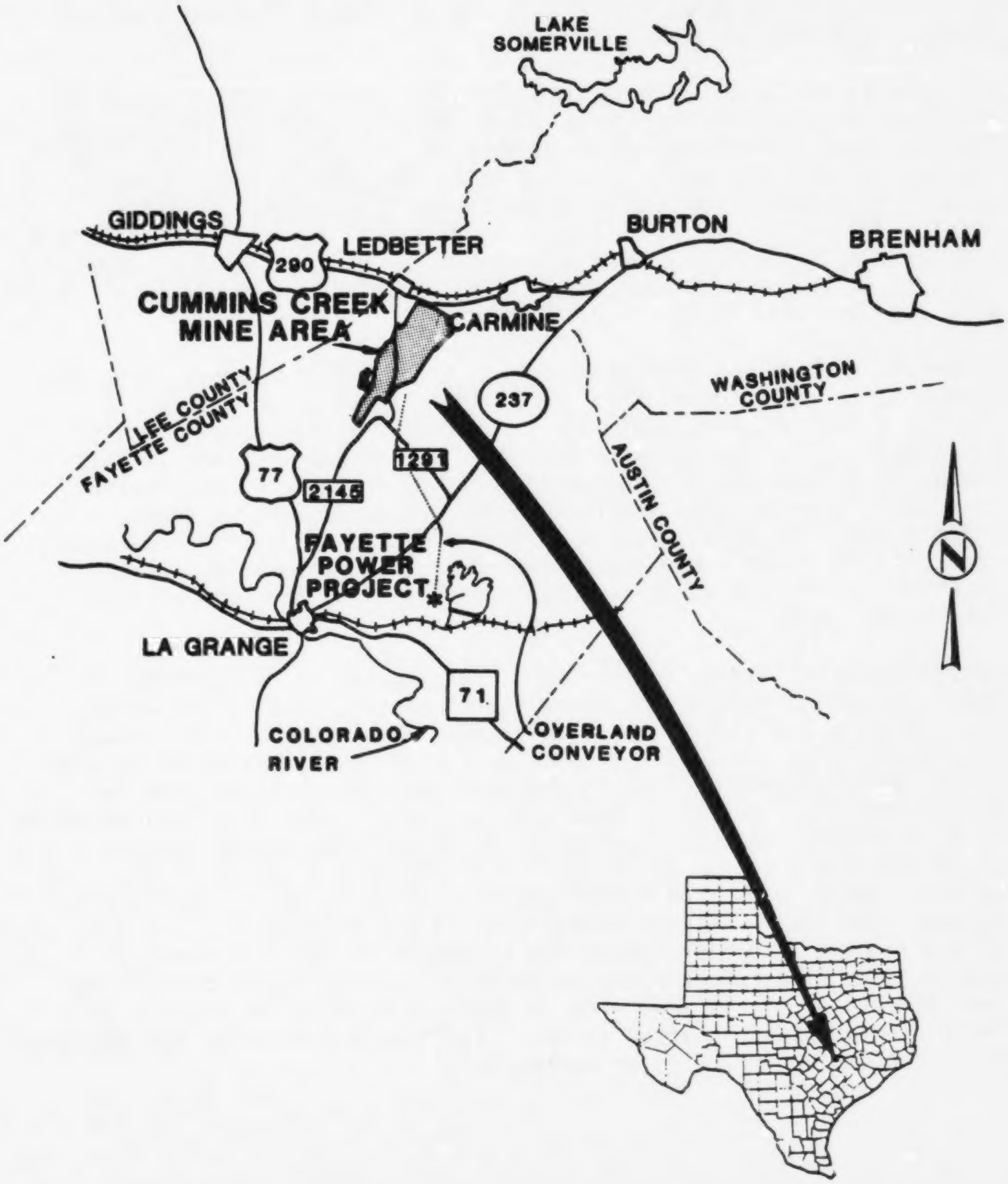
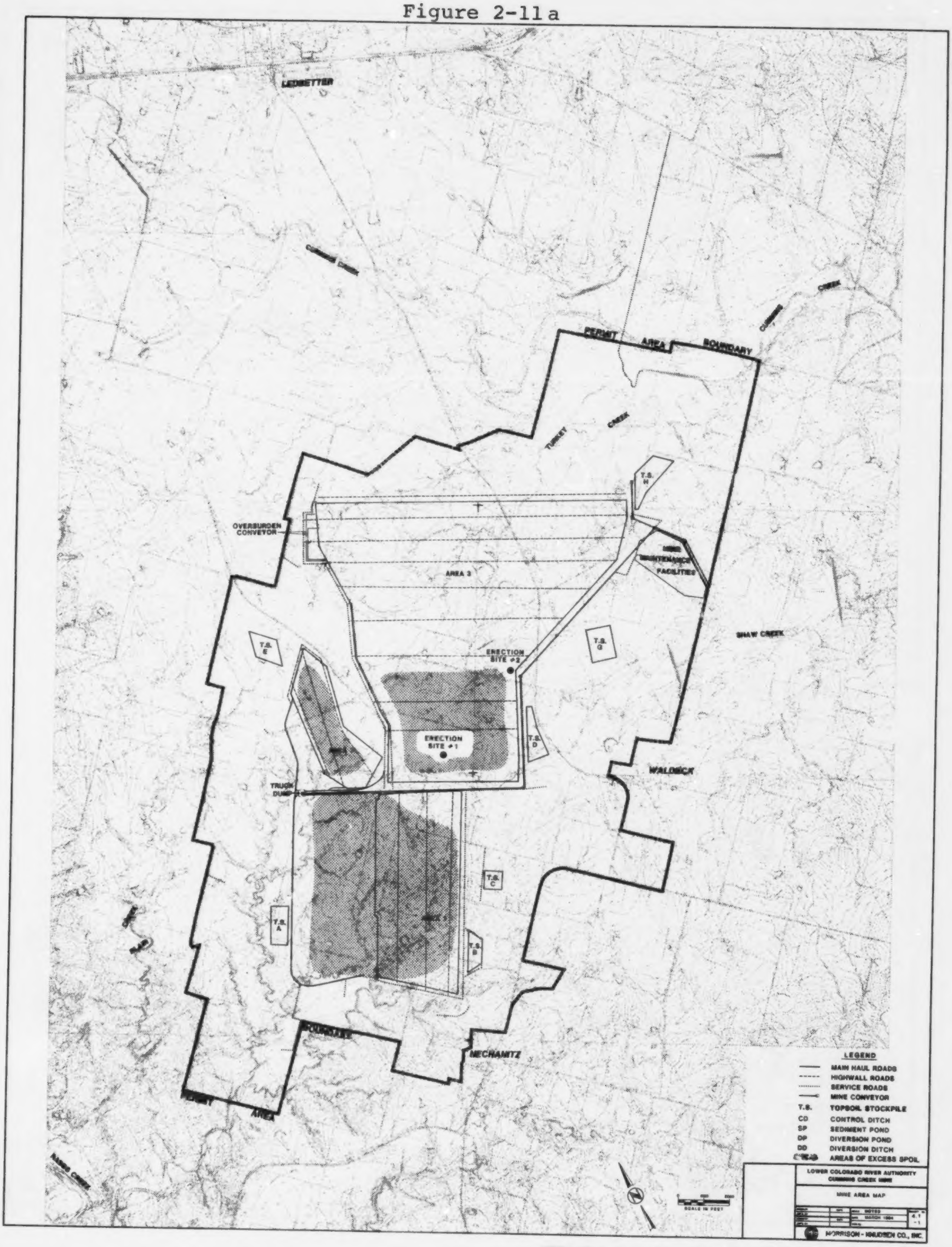
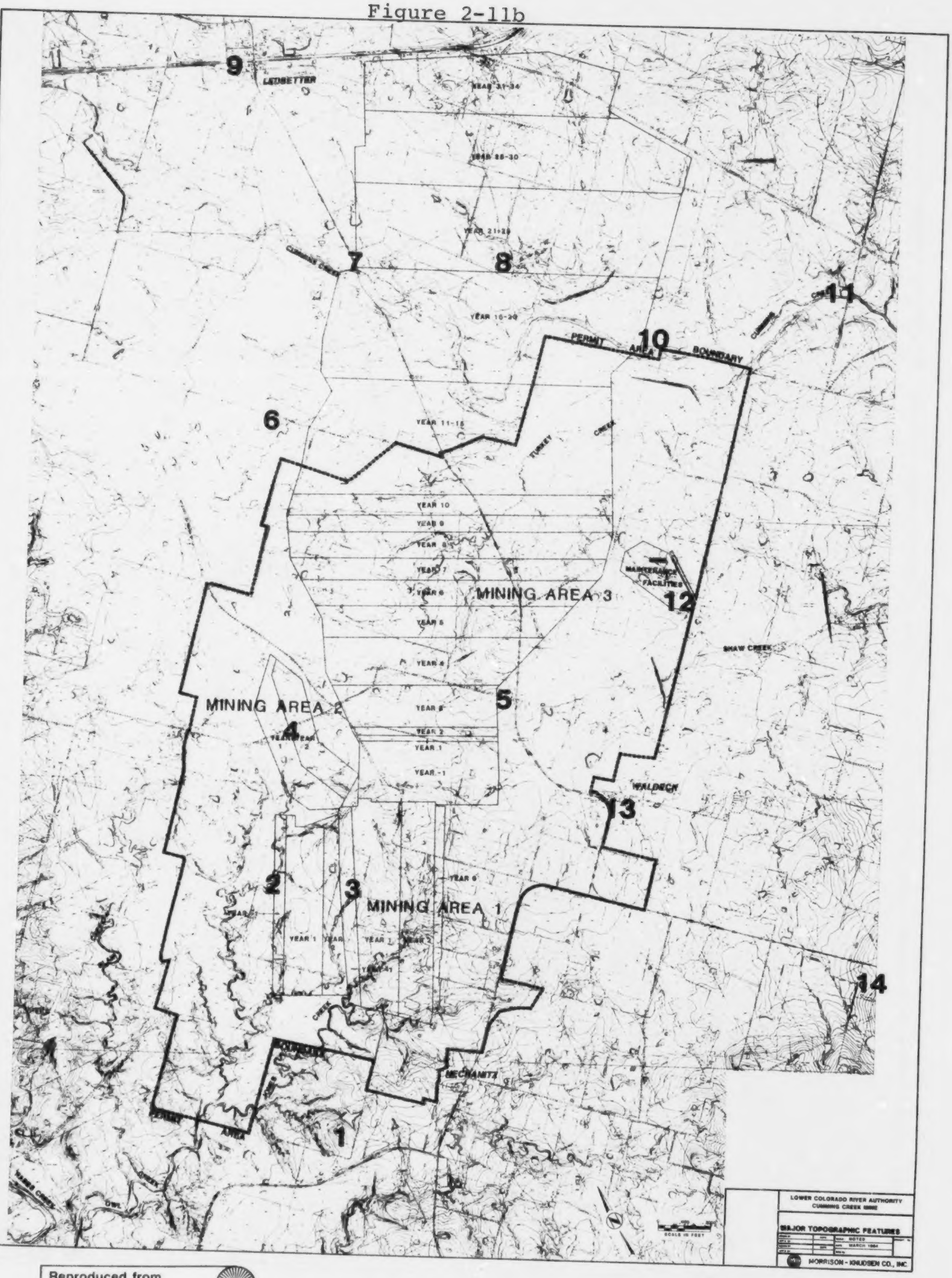

LAKE SOMERVILLE
GIDDINGS
290
LEDBETTER
BURTON
BRENHAM
CUMMINS CREEK MINE AREA
CARMINE
237
WASHINGTON COUNTY
LEE COUNTY
FAYETTE COUNTY
77
2145
1291
AUSTIN COUNTY
N
FAYETTE POWER PROJECT
LA GRANGE
71
COLORADO RIVER
OVERLAND CONVEYOR

Figure 2-11a


LEDBETTER
CUMMINS CREEK
CUMMINS CREEK
PERMIT AREA BOUNDARY
TURKEY CREEK
T.S. H
OVERSURDEN CONVEYOR
MINE MAINTENANCE FACILITIES
AREA 3
SHAW CREEK
T.S. E
T.S. G
ERECTION SITE #2
ERECTION SITE #1
T.S. D
WALDECK
TRUCK DUMP
T.S. C
T.S. A
T.S. B
BOUNDARY
MECHANITZ
PERMIT AREA
LEGEND
MAIN HAUL ROADS
HIGHWALL ROADS
SERVICE ROADS
MINE CONVEYOR
T.S. TOPSOIL STOCKPILE
CD CONTROL DITCH
SP SEDIMENT POND
DP DIVERSION POND
DD DIVERSION DITCH
AREAS OF EXCESS SPOIL
LOWER COLORADO RIVER AUTHORITY
CUMMINS CREEK MINE
MINE AREA MAP
NOTED
MARCH 1984
4.1-1
MORRISON - KNUDSEN CO., INC.
SCALE IN FEET

Reproduced from
best available copy.

Figure 2-11b


9
LEDBETTER
YEAR 31-34
YEAR 26-30
YEAR 21-25
7
8
YEAR 16-20
11
PERMIT AREA BOUNDARY
10
6
YEAR 11-15
TURKEY CREEK
YEAR 10
YEAR 9
YEAR 8
YEAR 7
YEAR 6
MINING AREA 3
MAINTENANCE FACILITIES
12
YEAR 5
SHAW CREEK
YEAR 4
5
MINING AREA 2
4
YEAR 3
YEAR 2
YEAR 1
YEAR -1
WALDECK
13
YEAR 6
2
3
MINING AREA 1
YEAR 1
YEAR 2
14
MECHANITZ
PERMIT AREA
1
OWL CREEK
SCALE IN FEET
LOWER COLORADO RIVER AUTHORITY
CUMMINS CREEK MINE
MAJOR TOPOGRAPHIC FEATURES
NOTED
MARCH 1984
MORRISON - KNUDSEN CO., INC

Reproduced from
best available copy.

TABLE 2-10
CUMMINS CREEK PROJECT
PRODUCTION SUMMARY

Description	
Total disturbed area	9,708 acres (9,586 in mine area, 122 in corridor area)
Total in-place BWE burden	1,147.6 million bcy
Total in-place dragline burden	802.8 million bcy
Total in-place burden moved	1,950.4 million bcy
Total lignite recovery	213.8 million tons
Strip ratio (effective)	9.8 bcy:ton
Annual lignite design production	6.4 million tons

Mine operations are proposed to begin in January 1987. BWE #1 will begin excavation development in Area #1 by prestripping burden ahead of the first dragline. During the third quarter of 1987, DL #1 will begin its first cut along the strike in Area #1. As the excavation in Area #1 proceeds, mobile equipment will develop a working face in the Box Cut of the Main Mine Area for BWE #2. In September 1988, BWE #2 will begin development of the initial Box Cut in the south end of the Main Mine Area (Area #3) west of Waldeck, operating in a west - east orientation. During the third quarter of 1989, BWE #1 will complete prestripping in Area #1 and will move into the Box-Cut area (Area #3) to assist BWE #2 in developing the normal BWE bench configuration. In the second quarter of 1990, DL #1 will leave Area #1 and will initiate operations in the subcrop region (Area #2) west of the Box Cut. This area will be stripped primarily by dragline. Early in 1991, the Area #3 Box Cut will completed by the BWEs and the Main Mine Area (Area #3) will be ready for normal operations. Upon completion of the Box Cut, DL #2 enters Area #3 to begin the dragline operation of the Main Mine Area. During the third quarter of 1992, DL #1 leaves Area #2 and joins DL #2 in the Main Mine Area to complete the final major equipment configuration.

During the course of normal operations, the BWE's would expose five lignite horizons. The upper four horizons, referred to as the 8500, 7500, 7400 and 6500 horizons, would be recovered as the burden material is removed. The lowest of the five horizons, referred to as the 5500 horizon, would be left with one foot of burden cover by the BWE's and would be handled as an in-pit inventory. The draglines would operate together to move interburden and release lignite from four horizons (the 4500, 3500, 3400 and 2500) below the BWE operating level. The BWE's would expose approximately 25 percent of the total lignite, while the draglines would expose approximately 75 percent.

Continuous surface miners were chosen for lignite loading due to the variability of lignite thickness within the Project Area and the need for removing thin partings. A front-end loader and/or a hydraulic backhoe would be available to supplement the CSM's as needed.

Lignite would be mined from three separate areas during the early years of mine operation. To provide the necessary lignite hauling flexibility, trucks would be used to remove lignite from the loading area and transport it to a truck dump outside of, but adjacent to, the mine. The truck dump will be a semiportable unit used to break and load the lignite delivered by trucks onto the mine conveyor system, which will then deliver lignite to a surge pile near the facilities site.

In early 1991, an in-pit truck dump/feeder-breaker unit will be operational at the level of 5500 horizon. Lignite in Area #3 will then be hauled to the in-pit truck dump location and fed onto an in-pit conveyor system which ties to the surface conveyor system. The out-of-pit truck dump/feeder-breaker will continue to receive lignite from Areas #1 and #2 until these area is exhausted (approximately Year 4 and 6, respectively). At that time the out-of-pit truck dump will be relocated into Area #3 along the in-pit conveyor system. Roads will be built and maintained as mining progresses and as needed for lignite haulage or access to the various areas in and around the mine.

Roads would be built and maintained as mining progresses and as needed for lignite haulage or access to the various areas in and around the mine.

Final burden placement would vary with the equipment used. Draglines would "cast" burden directly into the excavation created by the previous lignite recovery cycle. Burden removed by the BWE's would be transferred to an around-the-pit conveying system and placed over the dragline peaks to achieve approximate original contour. Dozers and graders would be used to complete the surface preparation prior to revegetation. In areas where draglines work alone, dozers and scrapers would grade the dragline peaks to achieve approximate original contour. The final depression left in Area #2 would be smoothed but is not planned to be completely filled. The depression would drain to the south and west.

During the initial years of box-cut development, it would be necessary to place burden material outside of the established mine boundary. Burden mined by the dragline would be placed in a series of spoil ridges along the western edge of the mining area. Burden removed by the BWE in the box cut would be conveyed out of the mine to a permanent overburden stockpile. The location of this site was selected such that burden placement by the BWE-associated spreaders would cover the burden material placed by the draglines in Area #1. By designing the burden disposal in this way, the number of additional undisturbed acres for outside placement of overburden was minimized.

An end-lake of approximately 845 water-surface acres (at the 370-foot MSL elevation) would be left at termination of the mining operation. The northern boundary of this final cut will be within the mine area near U.S. Highway 290. Dozers and scrapers would regrade the final cut wall to approximately 5 horizontal feet to 1 vertical foot slopes.

A number of civil features (roads, power lines, oil and gas wells, dwellings and other man-made structures) have been identified in the mining area. To maximize resource recovery, these civil features would be removed and relocated either permanently or temporarily without interrupting mining operations.

Ancillary facilities for the project include buildings to serve five major functions:

- Office
- Changehouse
- Shop/warehouse
- Tire maintenance/lube
- Wash facility

Expansion of the facilities can be accomplished through the use of standard building modules. Other capabilities at the site include:

- Welding shop
- Structural shop
- Machine shop
- Electrical shop
- Idler repair shop
- Conveyor belt shop
- Pump shop
- Warehouse
- Lubricant and fuel storage
- Water supply

Power to the mine pit area would be furnished at 69 kv. A 24.9-kv line will provide power to the facilities.

As mentioned previously, the mine conveyors interface a curved overland conveyor system, which transports the coal to the FPP. The overland conveyor would be completely enclosed at those locations where it crosses a water body. The total length of the overland conveyor system would be 12.1 miles. The system is designed to operate 16 hours per day, 5 days per week and 50 weeks per year.

A surge pile would be utilized to provide a relatively constant flow of lignite, up to a design capacity of 1800 tons per hour, to the overland conveyor system. The lignite conveyor would be located within a minimum 65-foot right-of-way, of which 55 feet will be fenced. Locally, additional width may be required to accommodate such special features as culverts, crossings or transfer stations. The overland conveyor would be paralleled by a 12 foot-wide gravel-surfaced road isolated inside the fenced right-of-way. This road, which will be accessed only through locking gates, will allow vehicle passage for inspection, maintenance and repair activities.

As with the mine, the overland conveyor line will be constructed, landscaped, and operated in a manner which minimizes potential environmental impacts. Right-of-way widths will be kept to a minimum to minimize impacts. Transfer points will be enclosed to abate noise and dust pollution.

2.10.2 Fayette Power Project

The Lower Colorado River Authority (LCRA) plans to expand the electric generating capacity of the Fayette Power Project (FPP). The FPP facility currently consists of two identical 600-megawatt (MW) coal-fired generating units (FPP Units 1 and 2) and one 400 MW lignite-fired unit (Unit 3) under construction scheduled for commercial operation in January 1988. Unit 4 is scheduled for commercial operation by mid-summer 1991. These additional two units would be located at the present power plant site, immediately adjacent to existing Units 1 and 2. All four units would utilize the existing 2,400 acre cooling reservoir.

Units 3 and 4 would be essentially identical and fueled by lignite from the Cummins Creek Mine, delivered at a rate of 6.4×10^6 tons/year. All four facilities are designed for continuous operation. Each unit will have a normal gross generating capacity of 417 MW and a maximum gross capacity of 462 MW. Pollution control equipment for these units includes electrostatic precipitators and wet SO_2 scrubbers.

The steam generators for Units 3 and 4 would be Combustion Engineering designed, subcritical pressure-type boilers with balanced draft fan systems. Superheater steam flow at maximum continuous rating (MCR) will be 3,100,00 lbs/hr at a pressure of 2.620 p.s.i.g. and a temperature of 1,005°F at the superheater outlet at each facility. At each unit, pulverizers would be fed lignite from overhead and mixed with heated air before being blown into the boiler firebox. Burners would be of the controlled excess air type with secondary combustion air supplied to the wind box by forced draft fans. Both primary and secondary air is preheated by regenerative air preheaters. The boiler would be tangentially fired and hot combustion gases would pass up through the furnace then horizontally across the pendant superheater and reheater sections. The gas is then turned downward and flows through the superheater and economizer section of the boiler. The gas then leaves the boiler and passes through vertical-axis regenerative air preheaters. Boiler exhaust gases then pass through the electrostatic precipitators, induced draft fans, sulfur dioxide removal system and exhaust gas reheater section before exiting through a 533 foot ground supported chimney.

2.11 ALTERNATIVES AVAILABLE TO EPA

The alternatives available to EPA center around the Agency's decisions regarding LCRA's applications for two NPDES (waste water discharge) permits. One of these permits is for discharges from the mining operation and one is for the discharges from the addition of power plant Units 3 and 4. Although many other agencies also have various regulatory decisions to make (see Section 2.12), the NPDES permit decisions are the only regulatory actions subject to the National Environmental Policy Act (NEPA). Because the Agency decided that the permit decisions constitute a "major Federal action[s] significantly affecting the quality of the human environment" (NEPA), EPA has prepared this EIS which considers all environmental ramifications of the project. This information will be used in making EPA's permit decisions and will serve to inform the public of the potential environmental consequences of this proposal.

The two alternatives available to EPA regarding its permit action are to: 1) issue the NPDES permit as proposed or with modifications; or 2) deny the NPDES permits. Issuing the NPDES permits as proposed would allow LCRA to: 1) construct and operate the Cummins Creek mining facilities and the Fayette Power Project Units 3 and 4 as described and; 2) discharge wastewater to the limits sets forth in the permits (See Appendix A, which contains copies of the draft permits). However, EPA may determine that special conditions should be made a part of the NPDES permits in order to minimize or avoid certain adverse environmental impacts. EPA may also decide to deny the NPDES permits if certain environmental resources are significantly adversely affected and the mitigation measures are insufficiant. Denying the NPDES permits could be a reason for LCRA to select another mining or power production alternative. The company could also decide to opt for the no action alternative and to purchase electricity from other sources.

2.12 ALTERNATIVES AVAILABLE TO OTHER AGENCIES

LCRA will be required to obtain permits and/or licenses from, or will be filing notices with, other regulatory agencies for construction and operation of the Cummins Creek Mine. In addition, several agencies have regulatory involvement with the Fayette Power Project Units 3 and 4. Table 2-11 presents the agency, type of application required, and the status of the application.

The U.S. Army Corps of Engineers (CE) may require a Section 404 permit for the discharge of dredged or fill material into waters of the United States including adjacent wetlands. The review of a Section 404 permit application for this project, including the environmental documentation, is the responsibility of the Galveston District of the CE. Alternatives available to the CE include: 1) approval; 2) approval with conditions or modifications; or 3) disapproval of the 404 permit. The proposed project may be authorized by a nationwide permit for structures, work and discharges for surface coal mining activities provided certain conditions are met (See 33 CFR 330.5(a)(21), 330.7(c)(2) and (3) and 330.7 (d)). The CE may also exercise its discretionary authority and require an individual permit be obtained for the activity. The Galveston District, CE, has addressed the 404 permit status of the Cummins Creek Project in a letter to EPA dated February 12, 1985. (See Chapter 4).

TABLE 2-11

REGULATORY REQUIREMENTS

AGENCY FEDERAL	REGULATORY REQUIREMENT	STATUS
EPA	National Pollutant Discharge Elimination System (P-mine)	Under Review
	National Pollutant Discharge Elimination System (P-modification, Units 3 & 4)	Under Review
	Spill Prevention Control & Countermeasure Plan (N-mine)	Not Submitted
	Prevention of Significant Deterioration (P-Unit 3)	Issued 1-24-84 for Unit 3
	Prevention of Significant Deterioration (P-Unit 4)	Under Review
Corps of Engineers	Section 404 of CWA (P-mine)	Application Pending
Mine Safety & Health Administration	Legal Identity Report (L-mine)	Issued 4-12-84
	Commencement of Mining (N-mine)	Not Submitted
	Mine Training & Retraining Plan (N-mine)	Not Submitted
	Impoundment Plans (P-mine)	Under Review
Federal Communication Commission	Industrial Radio (L-mine)	Not Submitted

TABLE 2-11
(continuation)

Soil Conservation Services	Modification SCS Structure (A-mine)	Under Review
STATE		
Texas Department of Water Resources	Water Appropriation (P-mine)	Under Review
	Wastewater Treatment System (P-mine)	Under Review
Railroad Commission	Surface Mining and Reclamation (P-mine)	Under Review
Texas Department of Health	Water Supply System (P-mine)	Not Submitted
Texas Department of of Highways	Road Access (P-mine)	Not Submitted
	Road Relocation (P-mine)	Not Submitted
Texas Air Control Board	Permit to Construct (P-Unit 3)	Issued 12-22-83
	* Lignite Storage & Handling System (P-Unit 3)	Issued 12-22-83
	* Limestone & Ash Handling System (P-Unit 3)	Issued 12-22-83
	Air Emissions (P-Unit 4)	Under Review
COUNTY		
Fayette County Comissioners La Grange, Texas	County Road Weight Limits (L-mine)	Not Submitted
	Floodplain Development	Under Review
Miscellaneous		
Cummins Creek Water Control Improvement District Waldeck, Texas	Use of Flood Control Structures (A-mine)	Under Review

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* LCRA has requested that these permits be revised to include Unit 4
P = Permit
L = License
N = Notice
A = Agreement

Livestock Production - Cummins Creek Mine Area

CHAPTER 3

ENVIRONMENTAL CONSEQUENCES OF ALTERNATIVES ON THE AFFECTED ENVIRONMENT

CHAPTER 3 - ENVIRONMENTAL CONSEQUENCES OF ALTERNATIVES ON THE AFFECTED ENVIRONMENT

3.1 SOCIOECONOMICS

3.1.1 Fiscal Resources

As with most significant economic activities, energy development induces socioeconomic change. Lignite development will produce short-term and long-term effects in Fayette, Lee and Washington Counties. Colorado County is not expected to experience significant effects from the mining activity because developed areas in Colorado County are more distant from the mine site. However, the towns in northern Colorado County could feel some effects from the construction and operation of Units 3 and 4 at the Fayette Power Plant.

Socieconomic impact projections in Fayette, Lee and Washington Counties were made, utilizing Texas A&M University's "Texas Assessment Modeling System" (TAMS). Texas Department of Water Resources data were used in making similar projections for Colorado County. These projections (see Appendix B) assume that there will be no direct tax revenues from the mining project and no available facilities for the in-migrant population. In considering the first assumption, increased property tax revenues may accrue to the political jurisdictions within the mine area due to higher land appraisals for properties in the mine area formerly classified as agricultural and due to potential ad valorem taxes on the lignite reserves. (In projects where the mining company is not tax exempt, yet another tax would be imposed on the mined lignite ore). In addition, the local portion of the sales tax for goods and services sold within the area will increase as business activity in general increases, generated by new employees working at either the mine or the power plant. Cities levying that additional 1% sales tax include Brenham, Burton, Carmine, Columbus, Fayetteville, Flatonia, Giddings, La Grange, Lexington, Round Top and Weimar. The second assumption regards the lack of available facilities for in-migrant population. In the late seventies, an oil boom hit the area; communities affected built additional facilities to accomodate the immigration of workers. Subsequently, that boom has slowed down and many workers have left, leaving overcapacity in some of the communities which had expanded such services as sewers, water systems, classrooms, etc., by the public sector.

Government Jurisdictions. The Fayette County Appraisal District, authorized by the Texas Legislature in 1979 under H.B. 692, serves as the appraiser for all government jurisdictions within Fayette County with taxing powers. Those jurisdictions within which the Cummins Creek Lignite Mine falls are: Fayette County, Round Top-Carmine Independent School District (ISD), the city of Round Top, and for the first time in 1985 the Lee-Fayette Cummins Creek Water Control and Improvement District #1.

The Appraisal District determines land values at current market value on January 1 of each year. The jurisdictions set their tax rates based on those land values the following August and tax bills are mailed in October of each year.

Certain properties are tax-exempt and therefore are neither appraised by the Appraisal District nor taxed by any of the governmental jurisdictions with taxing powers. Among those are: Federal, State, county and city properties and roads, schools, churches, and State legislated utilities such as the Lower Colorado River Authority.

Of the 604,160 acres in Fayette County, the following are tax exempt:

8,655 acres	Federal, state and local roads, buildings, etc., schools, churches.
6,191 acres*	LCRA - in ownership now or in the future.
14,846 acres	Total acres tax exempt
2.5%	Tax exempt as % of total Fayette County acreage

* - of this amount, 5,531 acres are in Fayetteville ISD, which is 11% of the total ISD acreage.

Revenue Sources. Property taxes are the major source of income for local taxing jurisdictions. Using the appraisal values determined by the Fayette County Appraisal District, tax rates are set each August to meet budgetary needs. For the first time in Texas history, according to House Bill 692, all property is appraised at 100% of its current market value. Table 3-1 shows the Tax Rates as applied to taxing districts in 1984. Table 3-2 lists 1984 rural land values for La Grange and Fayette County Ag-Use Land valuations. Using each, the beneficial effect of the agricultural use appraisal can be demonstrated as follows:

Data:	Rural land value	100 acres @ $1,700/acre =	$170,000
	Ag/use value (Native Pasture)	100 acres @ $85/acre	8,500

Tax rates:

Round Top/Carmine ISD	.39/$100 valuation
Fayette County	.24/$100 valuation
Round Top	+ .02/$100 valuation
Total Real Property Tax	.65/$100 valuation

Using these figures (assuming no change in tax rates)

Tax for owner of 100 acres in native pasture	$55.25/year
Tax for owner of 100 acres in non-ag land	$1,105.00/year

TABLE 3-1
TAX RATES 1984
FAYETTE COUNTY APPRAISAL DISTRICT

Taxing Jurisdiction	Dollars per $100 Valuation	
1. Fayette County	Gen. Fund	.15
	F.M. Road	.09
	TOTAL:	.24
2. Fayette Co. Water Control and Impr. Dist. (Monument Hill)	M & O	.00
	I & S	.41
	TOTAL:	.41
3. Fayetteville ISD	M & O	.58
	I & S	.12
	TOTAL:	.70
4. City of Fayetteville	M & O	.08
	I & S	.07
	TOTAL:	.15
5. Flatonia ISD	M & O	.575
	I & S	.005
	TOTAL:	.580
6. City of Flatonia	M & O	.14
	I & S	.00
	TOTAL:	.14
7. La Grange ISD	M & O	.53
	I & S	.05
	TOTAL:	.58
8. City of La Grange	M & O	.15
	I & S	.07
	TOTAL:	.22
9. Round Top-Carmine ISD	M & O	.39
	I & S	.00
	TOTAL:	.39
10. City of Round Top	M & O	.02
	I & S	.00
	TOTAL:	.02
11. City of Carmine	M & O	.00
	I & S	.20
	TOTAL:	.20
12. Schulenburg ISD	M & O	.40
	I & S	.10
	TOTAL:	.50
13. City of Schulenburg	M & O	.11
	I & S	.02
	TOTAL:	.13
14. Weimar ISD	Joined Colorado Co. AD	

NOTE: M & O = Maintenance and Operation I & S = Interest and Sinking Fund

Table 3-2

1984 RURAL LAND VALUES FOR LA GRANGE

Acres	Value Per Acre
0 Thru 1	$5,000.
1.1 Thru 5	3,500.
5.1 Thru 10	3,000.
10.1 Thru 20	2,600.
20.1 Thru 50	1,800.
50.1 Thru 100	1,700.
100.1 Thru 200	1,400.
200.1 Thru 300	1,200.
300.1 Thru 500	1,100.
500 Or More	850.

FAYETTE COUNTY AG-USE LAND VALUATION

Land Type	Description	Rents	Value Per Acre
1	Irrigated Cropland		$180
2	Improved Cropland		$130
3	Native Pasture	$8.50	$ 85
4	Woodland-Marginal Crop or Grazing	$8.50	$ 65
5	Orchards		$180
6	Improvements	-0-	See Market Value
7	Dryland Cropland	$15. $10.	$130
8	Commercial		See Market Value
9	Timberland		$300

In addition, the Property Tax Code describes the consequences of change in land use (in this case, the change from Ag-Use to mined land). When this occurs, an additional "roll back" tax would be imposed for each of the 5 years preceding the land use change. This additional tax would include the difference between the old tax (based on existing assessed values for agricultural land) and the new tax (based on an anticipated higher land use valuation), plus interest at an annual rate of seven percent.

Conclusion: The total appraised land values of taxing jurisdictions with lands in the mine area taken out of agricultural use will increase* during the years when the lands are being mined, during the 5-year bonding period when they are being reclaimed, and during the additional 5-year period when the owners are using them once more for agricultural purposes. An additional "roll back" tax would be imposed for the five years prior to the change in land use from Ag-Use to mining. This effect constitutes a major adverse impact on individual landowners and farmsteads. However, tax rates may consequently decrease since the cost of government which is the basis for setting a tax rate should not substantially increase.

$$\frac{\text{Cost of government}}{\text{Appraised Value}} = \text{tax rate (per \$100 valuation)}$$

The taxing jurisdictions have the authority to collect taxes on heavy equipment such as that used in the proposed mining operation. If that equipment is leased, the tax is collected from the owners. If LCRA purchases it as proposed then the tax-exempt status applies and no taxes are collected, resulting in an adverse long-term impact on Fayette County taxing jurisdictions and county residents.

Sales Taxes. The projected peak labor force of 1500 employees in 1988 is not expected to relocate entirely in the four-county study area. Some may in-migrate and some could locate in communities within 100 miles of the project area. Many may already live in the area. The annual peak payroll for those 1500 workers may exceed $42,000,000 with a related enhancement of business activity in the project area of $44,000,000 which represents a benefit for merchants and cities alike (local share of state sales tax). Of the many taxing jurisdictions in the four-county area that will benefit from the total expenditures of projected in-migrant labor forces, the cities and towns listed previously have levied the 1% local sales tax on goods and services over the 4.125% state sales tax. Though collected simultaneously by the State, the local share is returned to the local jurisdictions.

Taxing jurisdictions are entitled under law to levy ad valorem taxes on mineral reserves as well as on the minerals mined within their boundaries. Fayette County, for example, taxes property owners for the oil and gas reserves and the oil and gas companies for the resources produced from those reserves. In the case of the lignite reserves, until LCRA releases the location and estimated volume of those reserves to the Fayette County Appraisal District, the district cannot levy any taxes on them. Once mined, the lignite cannot be taxed because of the tax-exempt status of LCRA.

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*Currently no valuation of mined lands has been established; this example utilizes rural land value.

Local revenues from the taxes on the production from oil and gas wells which will be capped during the mine activity will decrease. They will be restored only if the wells are successfully reopened after mining and reclamation operations are completed.

Disposition of those wells including costs of reopening and of relocation of pipelines will be determined by agreement between the property or royalty owners, the oil and gas companies, the pipeline companies and LCRA before mining begins. Those agreements and conditions must meet Railroad Commission Regulations.

Expenditures of taxing jurisdictions. In almost every instance, the jurisdictions have sufficient capacity to absorb the demands of the in-migrant workers on hospitals, water and sewer systems, police and fire protection. Only the Brenham Independent School District, operating near or above capacity, may require additional classrooms if the number of in-migrants exceeds expectations.

Conclusion: Because of the mine activity, the jurisdictions of Round Top/Carmine Independent School District, the town of Round Top and Fayette County could experience increased revenues during the life of the mine, constituting [illegible] beneficial impact.

Residents/Property Owners. An estimated 38 residents would be relocated as a result of mining activities. These individuals or families should be paid the "fair market value" for their residences or farmsteads by LCRA, resulting in minimal economic adverse impacts. The phychological effects of these relocations are addressed in Section 3.1.7, Aesthetic Values. Property owners within the mine area will receive income from the lease of their property and from royalties on the mined lignite (if they own the mineral rights) according to lease agreements with LCRA that may also designate the pay-out period for those revenues. For those with producing oil and gas wells where production will be interrupted or terminated by the mine, future lignite revenues may be partially offset by losses of oil and gas royalties.

Property owners could experience the following economic effects during the mining period:

a. The additional property taxes for an estimated 17 years because of change from ag-use valuation (including when the mineral rights are owned by a second party) combined with the "roll-back" tax.

b. Ad valorem taxes on the lignite reserves, providing the Appraisal District receives data from LCRA.

c. Increased Federal income taxes.

d. Potential cash-flow problems if royalties and taxes do not coincide.

Property owners, whether by agreement or by condemnation, will receive compensation for the use of their property as right-of-way for the conveyor system during the 37-year life of the mine. Based on the latest discussions with the Fayette County Appraisal District, affected acreages within that right-of-way, however, should not lose its ag/use status.

Conclusion. Property owners in the mine area will receive income from leases and royalties (if they own the mineral rights), but the total of those monies will be reduced by increased property taxes due to changes in land appraisals, potential taxes on reserves, possible loss of oil and gas royalties, and possibly increased income taxes. These combined effects could result in some short-term adverse impacts on certain landowners. It is expected, however, that the majority of landowners affected should be beneficially impacted, particularly over the long-term.

3.1.2 Social And Cultural Patterns

The land use of Fayette County has been chiefly agricultural since the mid 1800's. Initially, public land was obtained for speculation purposes and later sold to homesteaders who developed farms. The majority of the settlers and land speculators coming to the area were generally old line southerners. This first wave was later replaced predominantly by Germans. The first German Settlement in the Cummins Creek area was established in 1843. German settlers who farmed lands along upper Cummins Creek left a rich heritage and many descendants, some of whom still live on the land and/or still own it. Many of the current landowners who actually live on the land have held the property since the mid-1930's. Some areas, such as Fayetteville, are almost entirely German-Czechoslovakian (Czech) in composition, and each of the four counties in the study area have significant populations of German, Czech, and Polish descent.

Surface mining, such as proposed, could have several social effects on local communities and populations, according to the National Resource Council (1981). New residents could settle in areas having close interactions within family and ethnic groups. Newcomers lacking knowledge of local customs and life styles may be disrespectful of them. Development created for new or relocated residents may differ from previous settlement patterns and spatial arrangements. Newcomers, or the local people themselves, with new employment and income opportunities different from traditional ones may induce a change in the community hierarchy of income, wealth and/or authority. The quality of life may be degraded in the view of local communities by sudden economic growth and/or a loss of self-sufficiency. Disturbance of the landscape could be a source of irritation in communities where an appreciation of a familiar landscape has developed. These potential effects on the social and cultural patterns of local communities and populations constitute minor, short-term, adverse impacts.

3.1.3 Schools

The following is a discussion of the ten Independent School Districts (ISD) and one Junior College in the four county project area.

The Brenham ISD, which serves Brenham and approximately 90 percent of Washington County, has the most severe overcrowding problem in the four-county study area. The schools are presently operating at a 175-percent capacity. Planned expansions will provide junior and senior high schools with excess capacities, but the elementary school will still be at a 113-percent capacity.

The Burton ISD is operating at 80-percent capacity at each level with a total capacity of 500 students. Renovation of existing structures is planned to provide more classrooms.

The Columbus ISD, serving New Ulm, Rock Island, Altair, Glidden and parts of Fayetteville and Ellinger, has a total capacity of 1,960 students with an average of 78-percent utilization of facilities for the elementary, junior and high schools.

The Fayetteville ISD has a capacity of 285 students and operates at 90-percent capacity. Plans are underway to expand the senior high facilities to include additional classrooms, a gymnasium and a band hall.

The Flatonia ISD utilizes 95-percent of their capacity with 460 students. Minor expansion and renovation is planned at each level.

The Giddings ISD, serving Giddings, Ledbetter, Somerville Lake and much of central Lee County, is operating at 75-percent capacity with 1,925 students. New vocational facilities are presently being constructed at the high school, and 46,000 square feet are being added to the elementary school.

The La Grange ISD serves La Grange, Plum, West Point and Ellinger. The elementary and middle schools are operating at 90-percent capacity while the senior high school is at 81-percent capacity. The district is in the planning stages for the expansion of the elementary and middle schools.

The Lexington ISD serves Lexington and approximately one half of rural Lee County. The total capacity is 830 with an average utilization of 66-percent of existing facilities.

The Round Top-Carmine ISD has a capacity of 600 students and utilizes 52 percent of their facilities. No expansion is planned.

The Schulenburg ISD serves Schulenburg, High Hill, St. John, Dubina, Ammansville, Freyberg, Swiss Alp, Engle, and part of Moravia. Utilization of facilities averages 83-percent capacity with 697 students. No expansion is anticipated in the near future.

The only institution of higher education located in the four-county study area is Blinn Junior College located at Brenham. The total enrollment for 1983 was 3,352 students. This facility serves local as well as rural students with day and night classes.

Schools would be affected by increased enrollments from new students of parent(s) employed at the proposed mine or power plant expansion. Of the eleven school systems identified, Brenham ISD was the only one recognized with potential to suffer indirect adverse impacts by receiving additional students. However, since Brenham ISD has already started adding to the middle school and has plans to expand its other facilities, the resulting impact should be minor and short-term.

Approximately 90% of the proposed mine is located within the Round Top-Carmine ISD. The proposed mining would indirectly affect this school district by changing the status of land use (i.e., would not qualify as agricultural land) on the tax rolls in Fayette County. This would result in additional taxes being paid to the school district by those individual landowners affected. This increase to the school district would be offset, however, by the loss of present tax revenues received from existing oil and gas operations in the proposed mine area. Since the real difference (in dollars) between these increases and decreases is unknown, the net monetary effect on the school district cannot be calculated. Nevertheless, considering the total acres proposed to be mined, the Round Top-Carmine ISD should realize a net gain in tax revenues from the mined area, constituting long-term beneficial impacts.

The Round Top-Carmine ISD would also be affected as the proposed mine advances from south to north. The county and farm-to-market roads that would be closed and relocated or replaced could affect the bus routes used to carry students to and from school. Some altered routes could result in the need for additional buses, as well as additional time and fuel requirements. These affects constitute long-term adverse impacts to the school district and could become major periodic adverse impacts if not properly coordinated to allow the ISD adequate time to make necessary changes or modifications.

The proposed overland conveyor and power plant Units 3 and 4 should not directly affect schools. Indirect effects on local/area school buses are assessed under "Transportation".

3.1.4 Transportation

Roads. There are Interstate Highways (IH), United States Highways (US), and State Highways (SH) crossing the four county project area, including IH 10, US 290 and 77, and SH 71 and 21. Of these, US 290 forms part of the northern boundary to the proposed mine and SH 71 provides access to the Fayette Power Plant from the southern end of the project area. In between, the major roadways through the mine area are Farm-to-Market (FM) 1291 from Ledbetter to Waldeck, then FM 2145 through to La Grange. Traffic volumes on US 290 average about 5,000 vehicles in 24 hours, while FM 1291 may have about 750 in 24 hours (LCRA, 1984a). There are also 11 county roads (CR) providing access to the farmsteads in the area.

The overland conveyor corridor would affect SH 237 and 159, FM 1291, and six county roads. The traffic volume on SH 237 north of Oldenburg runs about 2,000 vehicles in 24 hours, while traffic on FM 1291 between Walhalla and Warrenton runs about 550 per 24 hours (LCRA, 1984a). Traffic to and from the Fayette Power Plant is carried on SH 71, east of La Grange, Texas.

Certain roads would be directly affected by the proposed mine (Figure 3-1). Among these are CR 133 and FM 1291 which would be closed and relocated. County road 133 would be closed in 1986, with plans to relocate it around the western boundary of the mine. LCRA would construct a porton of this relocation with a new county road connecting CR's 133 and 137. This new county road (CR 138) in planned to join FM 3011 and 137. These links would eventually provide a new north-south route to Ledbetter from FM 3011, west of Nechanitz. Due to present land constraints, the timing of this western re-route is unknown.

LCRA would begin to relocate the new FM 1291 around the eastern side of the mine in 1985, and plans to close the old FM 1291 to traffic in 1990. The new route would follow CR 112 (upgraded to FM status) to CR 111, then turn left around the northeast corner of the mine to connect with US 290.

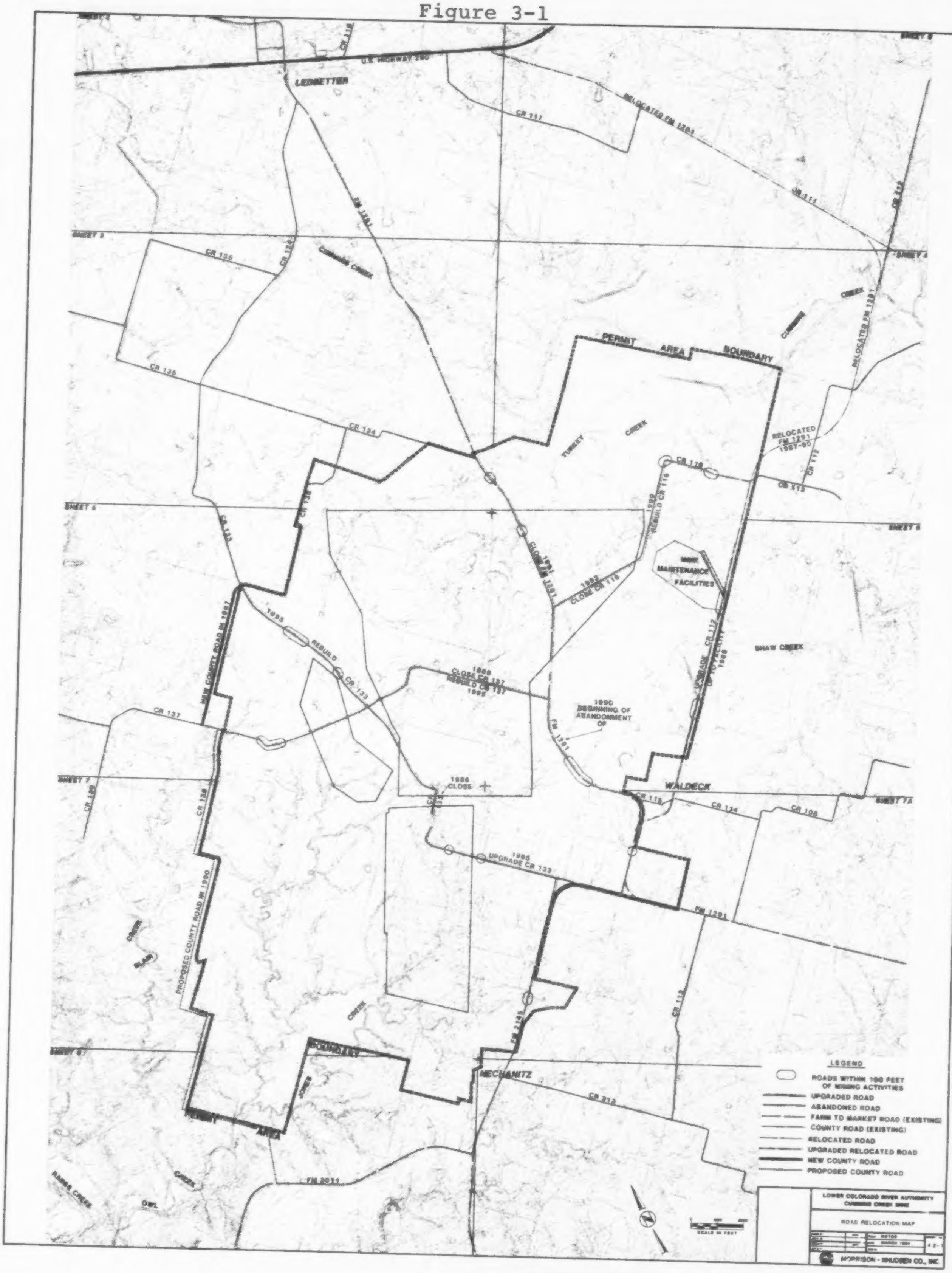
Other county roads would be closed during mining and rebuilt in the same location after the mine area has been reclaimed. These roads include CR 133 (closed 1986 and rebuilt 1995), CR 137 (closed 1988 and rebuilt 1999), and CR 117 (closed 2019 and not rebuilt). These closures and relocations would primarily affect the local residents and private landowners who daily or routinely travel these highways and roads.

The loss of the county roads for periods of 5-10 years constitutes a major, short-term, adverse impact on area traffic patterns and local residents. The closing and relocation of CR 133 and FM 1291 would constitute a major, long-term, adverse impact on area traffic patterns and local residents.

Some local traffic patterns would be affected indirectly by the proposed mine. Activities associated at the mine maintenance facilities area would increase traffic along CR 112. In addition, adjoining road traffic could be affected during rush hours and at intersections with relocated routes. These indirect effects constitute minor, long-term, periodic, adverse impacts on traffic patterns and local residents.

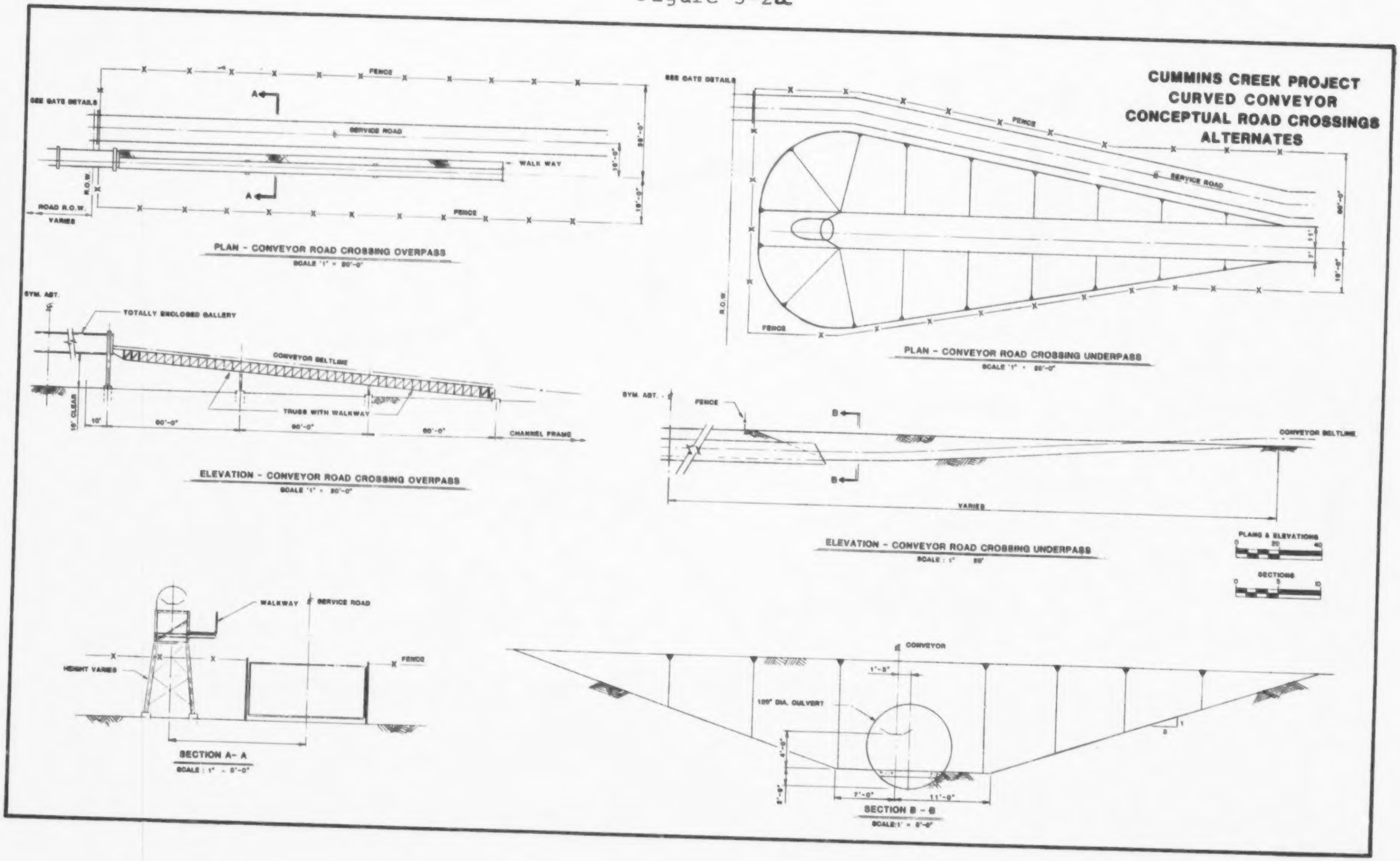
The overland conveyor will affect (i.e., by crossing or relocating) two highways, one FM road, nine county roads, and 10 private roads. LCRA plans that the conveyor would either span or go under existing roads. Figure 3-2a depicts two alternative designs for crossing of highways and roadways. While the underground crossing is preferred, utilization of either the tunnel or totally enclosed elevated crossing is dependent on LCRA's site specific considerations. Conveyor construction at public road crossings could indirectly affect traffic by causing passing motorists to slow down or stop. Since areas of construction along highways can be dangerous for workers as well as passing drivers, these zones would increase the potential for adverse transportation related impacts. Precautions (e.g., warning signals, signs, lights etc.) would be taken by LCRA to reduce the risk of traffic accidents within construction zones. Construction at private road crossings would affect certain landowners, constituting a short-term adverse impact. Activity (construction and operation) associated with the proposed Units 3 and 4 at the Fayette Power Plant would increase traffic on SH 71 resulting in minor adverse impacts on traffic and local residents, especially during plant shift changes when workers are entering or leaving plant site.

Figure 3-1


U.S. HIGHWAY 290
LEDBETTER
CR 118
CR 117
RELOCATED FM 1291
CR 111
FM 1291
CR 136
CR 135
CR 134
CR 133
CR 137
CR 138
CR 139
CR 112
CR 116
CR 113
CR 115
CR 114
CR 106
CR 213
PERMIT AREA BOUNDARY
TURKEY CREEK
CUMMINS CREEK
SHAW CREEK
MINE MAINTENANCE FACILITIES
RELOCATED FM 1291 1987-90
1999 REBUILD CR 116
1993 CLOSE CR 116
CLOSE FM 1291
1995 REBUILD
1988 CLOSE CR 137
REBUILD CR 137 1995
1990 BEGINNING OF ABANDONMENT OF
UPGRADE CR 112 1986
1986 CLOSE
1986 UPGRADE CR 133
NEW COUNTY ROAD IN 1987
PROPOSED COUNTY ROAD IN 1990
WALDECK
MECHANITZ
FM 2145
FM 2011
RABBS CREEK
OWL CREEK
JONES
SHEET 3
SHEET 4
SHEET 5
SHEET 6
SHEET 7
SHEET 7A
SHEET 8
SHEET 9
LEGEND
ROADS WITHIN 100 FEET OF MINING ACTIVITIES
UPGRADED ROAD
ABANDONED ROAD
FARM TO MARKET ROAD (EXISTING)
COUNTY ROAD (EXISTING)
RELOCATED ROAD
UPGRADED RELOCATED ROAD
NEW COUNTY ROAD
PROPOSED COUNTY ROAD
SCALE IN FEET
LOWER COLORADO RIVER AUTHORITY
CUMMINS CREEK MINE
ROAD RELOCATION MAP
MARCH 1984
MORRISON - KNUDSEN CO., INC.

Reproduced from
best available copy.

Figure 3-2a


CUMMINS CREEK PROJECT
CURVED CONVEYOR
CONCEPTUAL ROAD CROSSINGS
ALTERNATES
FENCE
SEE GATE DETAILS
SERVICE ROAD
WALK WAY
R.O.W.
ROAD R.O.W.
VARIES
A
35'-0"
10'-0"
10'-0"
PLAN - CONVEYOR ROAD CROSSING OVERPASS
SCALE 1" = 20'-0"
SYM. ABT.
TOTALLY ENCLOSED GALLERY
CONVEYOR BELTLINE
TRUSS WITH WALKWAY
10' CLEAR
10'
80'-0"
80'-0"
80'-0"
CHANNEL FRAME
ELEVATION - CONVEYOR ROAD CROSSING OVERPASS
SCALE 1" = 20'-0"
SEE GATE DETAILS
FENCE
SERVICE ROAD
R.O.W.
FENCE
90'-0"
11'
7'
10'-0"
PLAN - CONVEYOR ROAD CROSSING UNDERPASS
SCALE 1" = 20'-0"
SYM. ABT.
FENCE
B
CONVEYOR BELTLINE
VARIES
ELEVATION - CONVEYOR ROAD CROSSING UNDERPASS
SCALE : 1" 20'
PLANS & ELEVATIONS
0 20 40
SECTIONS
0 5 10
WALKWAY
SERVICE ROAD
HEIGHT VARIES
FENCE
SECTION A- A
SCALE : 1" - 5'-0"
CONVEYOR
1'-0"
120" DIA. CULVERT
4'-0"
5'-0"
7'-0"
11'-0"
1
2
SECTION B - B
SCALE:1" = 5'-0"

Railways. There are three railroad companies providing service in the project area. These include the Southern Pacific; the Atchison, Topeka and Santa Fe; and the Missouri, Kansas and Texas (MKT). The Fayette Power Plant presently utilizes western coal for Units 1 and 2, which is delivered from Wyoming and Montana by the MKT Railroad. The proposed addition of Units 3 and 4 at the Power Plant would not affect existing railroad lines or service, and there are no railroad lines affected by the proposed mine or conveyor. However, since the proposed project would increase traffic in the area, more motorists could be delayed at-grade rail crossings, increasing the potential for accidents and adverse impacts.

3.1.5 Land Use

Six general categories of land use exist in the project study area.

Cropland covers about one percent of the total study area. This land is planted in row crops (i.e., corn, oats and grain sorghum) and used as cattle feed rather than as a cash crop.

Pastureland covers about 36% of the total study area. It is used for cattle grazing, usually on coastal bermuda grass or a mixture with native grasses. Management practices (e.g., weed control, fertilizing, mowing and cattle rotation) are generally good (i.e., minimal overgrazing).

Grazingland covers about 17% of the total study area. It is also used for livestock production but is generally unimproved land. Depending on individual landowner need and resources, this land is upgraded parcel by parcel to pastureland. Management is less intensive, aimed mainly to prevent overgrazing, which has resulted in some areas reverting to native grasses.

Undeveloped Land includes about 41% of the total study area. This includes uncleared woodlands and old gravel mine areas. Most of these areas are tied into grazingland and pastureland and landowners have made efforts to improve the vegetation for cattle grazing.

Water Resources cover about 2% of the total study area. These consist primarily of cattle stockponds and the six existing SCS flood retarding structures. Most of these water bodies contain fish but are not actively managed. They also provide a water source for area wildlife as well as some hunting and fishing benefits.

Industrial/Commercial area cover about 3% of the total study area. These include active gravel mines and oil and gas well sites. The only permitted commercial gravel mine was partially flooded by SCS reservoir #4. There are many oil and gas well (producing and nonproducing) sites. The average site is about seven acres and contains the well, storage tanks, containment pond, and an access road. Exploration is continuing but is not as intensive as the "boom" of the late 1970's.

The land use categories within the proposed overland conveyor corridor are the same as those for the mine study area but the percentages are different. The proposed overland conveyor study area consists of about 4% cropland, 30% pastureland, 31% grazingland, 27% undeveloped land, 4% water resources and 4% industrial/commercial.

The land use for the area proposed for Units 3 and 4 at the Fayette Power Plant is devoted to electric power generation.

LCRA's post-mining land use plan is designed to maintain, to the extent possible, present land use categories and acreages. Table 3-3 illustrates the small changes envisioned by LCRA for each of the existing land use categories. Realistically, however, land use after reclamation is dependent on individual landowner preferences and lease agreements. LCRA contacted each of the 88 landowners that would have land to be reclaimed after mining and requested that they complete a survey form indicating any proposed land use changes. Table 3-4 presents the results of this survey. The difference between Tables 3-3 and 3-4 is important in recognizing the potential effects of the proposed mine on land use. LCRA post-mining plan projects about 5% increase in agricultural land, and the landowner survey indicates a potential conversion of approximately 20% from undeveloped land to grazing, pasture or crops for livestock. The aquatic land-use category would be increased substantially by construction of surface water control structures and the end lake. A change in land use would not, in itself, constitute an adverse impact since it would occur at the request of the individual landowners. However, the secondary effects of the total potential land use changes on other resources (e.g., fish and wildlife) may be adverse. These are assessed in separate sections according to their subject heading.

It is noted that although only one percent of the present land use is cropland, no cropland (except for livestock feed or orchards) is planned for postmining. The SCS encourages the consideration of cropland as a postmine land use to fully demonstrate reclamation capabilities to support all uses. The use of cropland is a good means to condition the soil and helps build organic matter and tilth. A major limiting factor in cropland as a postmine land use is the high potential for erosion which could result in LCRA violating its NPDES permit for the mine. Nevertheless, LCRA agrees that some postmine areas may be applicable (i.e., having minimal runoff) to demonstrate how crops could be raised where previously restricted because of subsoils.

The proposed overland conveyor would affect individual farmsteads by eliminating the land use within the 65 to 100 foot right-of-way. The amount of land removed on individual acreages would vary, but the total acrage to be affected is approximately 200 acres over the 12 mile route. This loss of land use for the life of the proposed project constitutes major, long-term, adverse impacts on individual farmsteads.

The proposed addition of Units 3 and 4 at the Fayette Power Plant would not affect land use since the entire power plant site is devoted to electric power generation.

3.1.6 Land Productivity

The proposed mine would affect land productivity on approximately 88 individual farmsteads. Productivity would be lost from the first stage of mining to the end of the 5-year bond release period. Completing this cycle would take an average of about 10 years. As the mind advances, the amount of land taken out of production each year would be approximately 300-500 acres. This irretrievable loss of land productivity over the life of the mine constitutes a major long-term adverse impact.

TABLE 3-3
CUMMINS CREEK MINE PLAN
PRE- AND POST-MINING LAND-USE ACREAGES

Land Use	Pre-Mining Acreage	Post-Mining Acreage
Cropland	90	90
Pasture	4,195	4,245
Grazingland (Range)	1,000	1,470
Undeveloped (Woodland)	3,800	3,355
Developed Water Resources*	150	120
Industrial	165	120
Total	9,400	9,400

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* Does not include small stock ponds, which would be replaced according to landowner requests.

TABLE 3-4

LANDOWNER PREFERENCE SURVEY

No. Landowners Contacted: 88
No. Landowners Responding: 29 (33%)

	Pre-Mine		Post-Mine	
Land Use	Acres	%	Acres	%
Cropland	24.9	1	389.2	15*
Pastureland	1087.3	41	1270.5	48
Grazingland	360.7	13	352.1	13
Water	54.7	2	59.0	2
Industrial	28.7	1	24.6	1
Undeveloped	1110.6	42	570.5	21**
Total	2666.9		2666.9	

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* Cropland for livestock feed grains; orchards
** Convert undeveloped to pastureland

After reclamation is completed, the level of productivity could be affected. Considering the many variables involved, it would be unlikely that landowners would see exactly the same level of productivity after mining as before. However, because the reclamation plan includes replacing the topsoil, the chance of a serious problem causing a major adverse impact on productivity should be minimal. Since there is a recognized shortage of topsoil from sand and gravel operations, reclamation in these northern areas using mixed overburden should improve productivity. Overall, the total mine area could have a net increase in agricultural productivity, resulting mainly from the projected conversion of about 20% of undeveloped land to agricultural land.

Land productivity is largely dependent on the management decisions and conservation practices of individual landowners. Coastal bermudagrass is a widely adapted and used pasture species which responds well to management inputs. Its major limitation involves its need for fertility and management. Since a common element among farmstead managers with improved pastures (e.g., coastal bermudagrass) is the need for fertilizer, its future costs could be a key factor in determining the level of productivity on these reclaimed farmsteads.

LCRA reported that landowners apply about 200 to 300 lb/ac of nitrogen-based fertilizer once or twice a year to pastureland or cropland. After the lands are reclaimed and returned, some landowners may be affected by increased fertilizer requirements. This potential increase in the use of fertilizer (i.e., required to maintain productivity) constitutes an adverse impact on these farm managers. A consideration for reducing this potential adverse impact would be to compare the use of other grasses (monocultures or mixtures) to coastal bermuda grass for reclaimed pasture and grazing lands. Other grasses may be used for grazing and/or for hay production and could be overseeded with legumes for greater utilization. Table 3-5 includes examples of seed mixtures included in LCRA's revegetation plan.

Landowners with producing oil and gas wells would have this land use affected when the wells are capped prior to mining. The loss of oil and gas production during mining constitutes an adverse impact on landowners and one that could be compensated for in damages paid by LCRA, subject to negotiations with oil and gas companies and legal rights. The actual oil and gas reserves should not be affected by mining; therefore, this land use may be re-established after reclamation is complete, but would be done at the landowners' expense.

The overland conveyor would affect about 21 individual farmsteads by creating a fenced barrier across their land with a limited number of crossings. In some cases, this barrier may restrict certain farm operations which could in turn reduce productivity. This potential reduction in land productivity over the life of the project constitutes a minor or major, long-term, adverse impact on those individual farmsteads.

Proposed Units 3 and 4 at the Fayette Power Plant would not affect land productivity since the area is within the plant site and presently devoted to electric power generation. The proposed units may, however, affect land productivity on nearby farmsteads. Complaints have been raised in the past by some residents regarding the effects noise and emissions from

Table 3-5
CUMMINS CREEK MINE
REVEGETATION SEED MIXTURES

Pasture

Coastal bermudagrass (*Cynodon dactylon*)	48 bushels of sprigs/acre
Kleingrass Var. "Selection 75" (*Panicum* coloratum)	4 lbs PLS/acre
Vetch (*Vicia sp*.)	3 lbs PLS/acre

Grazingland

Mixture 1*	lbs PLS/acre**
Common Bermudagrass (*Cynodon dactylon*)	2
Kleingrass Var. "Selection 75" (*Panicum coloratum*)	2
Bahiagrass Var "Pensacola" (*Paspalum notatum*)	2
Medio bluestem (*Andropogon nodosus*)	1
Arrowleaf clover (*Trifolium vesiculosum*)	1
Total	8

Mixture 2	lbs PLS/acre
Green sprangletop (*Leptochloa dubia*)	2
Buffelgrass Var "Laurisa" (*Cenchrus ciliarus*)	2
Little bluestem (*Andropogon scoparius*)	2
Switchgrass Var "Alamo" (*Panicum virgatum*)	2
Subterranean clover (*Trifolium subterraneum*)	1
Total	9

Mixture 3	lbs PLS/acre
Old World bluestem Var "T-587" (*Dichanthium* spp.)	1
Buffalograss (*Buchloe dactyloides*)	2
Sideoats grama Var "Haskell" (*Boutelous curtipendula*)	3
Indiangrass Var "Lometa" (*Sorghastrum nutans*)	2
Arrowleaf clover (*Trifolium vesiculosum*)	1
Total	9

Table 3-5

(Continued)

Disturbed Areas

	lbs PLS/acre
Common Bermudagrass (*Cynodon dactylon*)	2
Bahiagrass Var "Pensacola" (*Paspalum notatum*)	2
Kleingrass Var "Selection 75" (*Panicum coloratum*)	2
Lovegrass Var "Renner" (*Eragrostis curvula*)	1
Vetch (*Vicia sp.*)	1
Total	8

Fish and Wildlife Habitat

	lbs PLS/acre
Switchgrass Var "Alamo" (*Panicum virgatum*)	4
Indiangrass Var "Lometa" (*Sorghastrum nutans*)	4
Arrowleaf clover (*Trifolium vesiculosum*)	2
Maximilian sunflower (*Helianthus maximiliani*)	1
Illinois bundleflower (*Desmanthus illinoensis*)	1
Total	12

Aquatic Vegetation***

Cattail (*Typha* spp.)
Shoreline Common reed (*Phragmites australis*)
Reed canary grass (*Phalaris arundinacea*)
Japanese millet (*Echinochloa crusgalli*)

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* Seed mixtures were developed on the basis of seeding approximately 100 pure live seeds per square foot. All mixtures are in pounds of pure live seed (PLS). All seed mixtures and planting requirements are approximations.

** Seeding rates are based on drill seed application. Broadcast seeding application should require doubling the seed drill application rate. Legumes will be drill seeded during the fall season.

*** Aquatic vegetation will be planted according to specified recommendations.

Units 1 and 2 have had on their operations. The proposed expansion of existing facilities could cause similar situations to occur over the life of the project. This potential secondary effect on land productivity constitutes a periodic, short-term, indirect adverse impact on nearby residents and/or farmsteads.

3.1.7 Aesthetic Values

Aesthetic values include the subjective judgements of individuals, families or groups. They can be important because people are sometimes more vocal over aesthetic values than over material ones. It is expected that not all absentee landowners are in favor of the proposed project, and not all resident landowners are opposed to it. Also, it is expected that those resident landowners with a long family history on their land would not be "affected" in the same way as absentee landowners.

Individuals and families that would be affected by the proposed project can be divided into the following five groups:

Group A includes those persons that would be affected by the actual mining. There are approximately 18 full-time residents, 19 part-time residents, and one commercial establishment that would require relocation over the life of the mine (Table 3-6). These direct effects constitute major, short-term or long-term, adverse impacts on aesthetic values of these individuals or families.

Group B includes those persons that would be affected by retention dams or other ancillary facilities associated with the proposed mine. These facilities would affect approximately 15 to 20 full-time or part-time residents over the life of the mine. These direct effects constitute potential major, short-term or long-term, adverse impacts on aesthetic values of these individuals and families.

Group C includes those persons that would be affected by the proposed overland conveyor (Table 3-7). There are approximately 23 full-time residents, 9 part-time residents, and 2 commercial establishments that would be affected by construction and/or operation of the conveyor over the life of the mine. These direct effects constitute potential major, long-term, adverse impacts on aesthetic values of these individuals and families.

Group D includes those persons in close proximity to the proposed mine, conveyor, or power plant expansion but without lands directly affected. There are approximately 51 full-time residents, 18 part-time residents, and eight commercial establishments that would be indirectly affected over the life of the proposed mining operation. There are approximately 32 full-time residents, six part-time residents, and one commercial establishment indirectly affected by the proposed conveyor. There are approximately 20 full-time residents, and five part-time residents across from the power plant that would be indirectly affected over the life of the expanded operation. These indirect effects constitute potential minor, periodic, short-term, adverse impacts on aesthetic values of these individuals or families.

Table 3-6

INDIVIDUALS AND/OR FAMILIES POTENTIALLY AFFECTED BY PROPOSED LIGNITE MINE

Mine Years	Full-Time Residences Direct	Full-Time Residences Indirect	Part-Time Residences Direct	Part-Time Residences Indirect	Commercial Direct	Commercial Indirect
0 to 5	2	9 south 19 east 4 west	7	7 east 4 west	0	1 south 3 east
6 to 10	7	6 east 2 west	8	4 east 3 west	1	0
11 to 35	9	1 north 10 west	4	0	0	4 west
Totals	18	51	19	18	1	8

Table 3-7

INDIVIDUALS AND/OR FAMILIES POTENTIALLY AFFECTED BY PROPOSED OVERLAND CONVEYOR (3 flight)

	Full-Time Residences	Part-Time Residences	Commercial
Located within 1000 ft.	23	9	2
Located between 1000 & 2000 ft.	20	2	0
Located outside 2000 ft.	12	2	1
Totals	35	15	3

Group E includes those persons located in nearby towns or in neighboring counties that would be indirectly affected by the proposed project. There are thousands of people in the four county study area that may never actually see the proposed project, except briefly when passing through the immediate area. These indirect effects constitute potential, occasional adverse impacts on aesthetic values of these individuals or families.

3.1.8 Demography

Tables 3-8, 3-9, 3-10, and 3-11 present 1970 and 1980 census data for Fayette, Lee, Washington and Colorado Counties, respectively. These tables show that all four county populations increased during this period, particularly within the 20-34 age brackets. Table 3-12 presents census data over the past four decades for the same counties. This table shows that even though populations increased from 1970 to 1980, the net change has been an overall reduction of 18.1%. Reducing populations more accurately depicts past trends for many agricultural areas. Certain factors have been responsible for this rural to urban migration of unskilled or semi-skilled labor. These include reduced demands resulting from advanced methods and machinery that no longer use manual labor, as well as the increased demand for labor by commercial and industrial operations.

The population increases from 1970 to 1980 apparently reversed this past trend. This was due in part to job opportunities provided by the Fayette Power Plant and the oil and gas exploration "boom". The manpower requirements of the proposed project should help to regenerate this past trend. The effect of providing additional jobs and reducing future out-migration constitutes a beneficial impact on demography.

3.1.9 Housing

Until quite recently, there had been a housing shortage in the four county study area. Oil and gas exploration and development had filled almost all available housing including single family units and apartment complexes. By 1982, the slowdown in oil field work in the area increased housing availability. Table 3-13 presents a general picture of the existing and planned conditions for several communities in the area. Housing availability varies among communities although most town and cities anticipate adequate housing.

Building activity could increase in some towns and cities to accomodate the proposed project and rental property in foreseen as a high priority.

Table 3-14 compares the projected manpower requirements for the proposed mine and Units 3 and 4. The table demonstrates that the majority of workers for the first four to five years would be needed for construction at the power plant. In addition, construction activity at the mine would peak quickly and last for about two years. After the sixth year, there would be very little construction, and manpower requirements for continued operations would be slightly higher for the mine than for the power plant.

TABLE 3-8
CUMMINS CREEK PROJECT
SOCIOECONOMIC & DEMOGRAPHIC PROFILE OF FAYETTE COUNTY

Population

	1970	1980
Fayette County	17,650	18,832
Carmine	--	239
Fayetteville	400	356
Flatonia	2,969	2,809
La Grange	3,092	3,768
Round Top	94	87
Schulenburg	2,294	2,469

Density

		1970	1980
Area	934 Sq. Mi.		
Persons/Sq. Mi.		18.90	20.16

Age-Sex

	1970			1980		
	M	F	Total	M	F	Total
0-4	443	425	868	615	570	1,185
5-9	628	569	1,197	602	526	1,128
10-14	733	754	1,487	573	588	1,161
15-19	763	726	1,489	724	670	1,394
20-24	351	332	683	666	581	1,247
25-29	300	314	614	630	572	1,202
30-34	304	307	611	542	466	1,008
35-44	747	822	1,569	836	781	1,617
45-54	1,109	1,223	2,332	900	971	1,871
55-59	664	752	1,416	560	640	1,200
60-64	712	699	1,411	639	717	1,356
65+	1,750	2,223	3,973	1,936	2,527	4,463
Total	8,504	9,146	17,650	9,223	9,609	18,832

Race

	1970	
	Persons	%
White	15,540	88.0
Negro	2,065	11.7
Other	45	.3
Total	17.650	100.00

Education (25 years of age and older)

% High School Graduates	21.40
% Some College (1-3 yr.)	4.01
% College Degree	4.81
Median Years School	8.10

Nationality

Native of Native Parents	13,990
Native of Foreign or Mixed Parents	3,457
Foreign Born	203

TABLE 3-9
CREEK PROJECT
SOCIOECONOMIC & DEMOGRAPHIC PROFILE OF LEE COUNTY

Population	1970	1980
Lee County	8,048	10,952
Giddings	4,359	6,394
Lexington	719	1,065

Density		1970	1980
Area	637 Sq. Mi.		
Persons/Sq. Mi.		12.63	16.63

Age-Sex	1970			1980		
	M	F	Total	M	F	Total
0-4	263	228	491	403	406	809
5-9	307	300	607	395	369	764
10-14	400	376	776	465	377	842
15-19	410	364	774	788	405	1,193
20-24	146	169	315	439	397	836
25-29	145	160	305	426	345	771
30-34	153	149	302	290	288	578
35-44	388	436	824	572	532	1,104
45-54	474	468	942	524	533	1,057
55-59	291	301	592	278	279	557
60-64	259	298	557	263	296	559
65+	699	864	1,563	848	1,079	1,927
Total	3,935	4,113	8,048	5,646	5,306	10,952

Race	1970		1980	
	Persons	%	Persons	%
White	6,260	77.8	9,141	83.5
Negro	1,698	21.1	1,757	16.0
Other	90	1.1	54	.5
Total	8,048	100.0	10,952	100.0

Education (25 years of age and older)	
% High School Graduates	24.40
% Some College (1-3 yr.)	4.08
% College Degree	4.10
Median Years School	8.50

Nationality	
Native of Native Parents	6,941
Native of Foreign or Mixed Parents	1,028
Foreign Born	79

TABLE 3-10
CUMMINS CREEK PROJECT
SOCIOECONOMIC & DEMOGRAPHIC PROFILE OF WASHINGTON COUNTY

Population	1970	1980
Washington County	18,842	21,498
Brenham		
Burton	8,922	10,966
	---	325

Density		1970	1980
Area	594 Sq. Mi.		
Persons/Sq. Mi.		31.72	37.03

Age-Sex	1970			1980		
	M	F	Total	M	F	Total
0-4	647	596	1,243	723	752	1,475
5-9	793	733	1,526	782	715	1,497
10-14	917	779	1,693	802	759	1,561
15-19	1,084	895	1,979	1,202	1,068	2,270
20-24	545	515	1,060	990	801	1,790
25-29	421	436	857	757	756	1,513
30-34	352	378	730	633	655	1,288
35-44	924	956	1,880	1,028	1,043	2,071
45-54	984	1,107	2,091	1,006	1,142	2,184
55-59	554	613	1,167	532	616	1,148
60-64	524	623	1,147	503	626	1,129
65+	1,497	1,969	3,466	1,710	2,362	4,072
Total	9,242	9,600	18,842	10,703	11,295	21,998

Race	1970		1980	
	Persons	%	Persons	%
White	13,645	72.4	16,791	76.3
Negro	5,165	27.4	4,860	22.1
	32	.2	347	1.6
Total	18,842	100.0	21,998	100.0

Education (25 years of age and older)	
% High School Graduates	30.85
% Some College (1-3 yr.)	9.71
% College Degree	6.86
Median Years School	8.80

Nationality	
Native of Native Parents	
Native of Foreign or Mixed Parents	16,434
Foreign Born	2,235
	173

TABLE 3-11
CUMMINS CREEK PROJECT
SOCIOECONOMIC & DEMOGRAPHIC PROFILE OF COLORADO COUNTY

Population	1970	1980
Colorado County	17,638	18,823
Columbus	3,342	3,923

Density		1970	1980
Area	949 Sq. Mi.		
Persons/Sq. Mi.		18.59	19.83

Age-Sex	1970			1980		
	M	F	Total	M	F	Total
0-4	654	598	1,252	707	693	1,400
5-9	764	769	1,533	655	605	1,260
10-14	1,000	948	1,948	762	696	1,458
15-19	964	844	1,808	841	903	1,744
20-24	393	433	826	767	642	1,409
25-29	397	395	792	716	635	1,351
30-34	372	414	786	509	540	1,049
35-44	878	975	1,853	920	939	1,859
45-54	1,055	1,043	2,098	973	1,028	2,001
55-59	512	563	1,075	539	557	1,096
60-64	509	539	1,048	503	533	1,036
65+	1,083	1,536	2,619	1,348	1,950	3,298
Total	8,581	9,057	17,638	9,240	9,583	18,823

	1970		1980	
	Persons	%	Persons	%
White	13,531	76.7	15,378	81.7
Negro	4,066	23.1	3,395	18.0
Other	41	.2	50	.3
Total	17,638	100.0	18,823	100.0

Education (25 years of age and older)	
% High School Graduates	25.45
% Some College (1-3 yr.)	5.86
% College Degree	4.09
Median Years School	8.80

Nationality	
Native of Native Parents	15,642
Native of Foreign or Mixed Parents	1,859
Foreign Born	137

TABLE 3-12
CUMMINS CREEK PROJECT
POPULATION CHANGE IN THE FOUR-COUNTY STUDY AREA

Year	Colorado	Fayette	Lee	Washington	Total
1940	17,812	29,256	12,751	25,387	85,196
% Change 1950	-1.3	-17.3	-20.4	-19.1	-15.0
1950	17,576	24.176	10,144	20,542	72,438
% Change 1960	+5.0	-15.7	-11.8	-6.8	-7.6
1960	18,463	20,384	8,949	19,145	66,941
% Change 1970	-4.5	-13.4	-10.1	-1.6	-7.1
1970	17,638	17,650	8,048	18,842	62,178
% Change 1980	+6.7	+6.9	+31.6	+14.1	+12.2
1980	18,823	18,832	10,592	21,498	69,745
% Change 1940-1980	5.7	-35.6	-16.9	-15.3	-18.1

Source: U.S. Bureau of the Census; Census of Population, 1940, 1950, 1960, 1970, 1980.

Table 3-13

CUMMINS CREEK PROJECT
AVAILABLE HOUSING IN THE FOUR-COUNTY STUDY AREA BY CITY

	Existing				Planned			
Community	Single Family	Apartments	Mobile Homes	Ad Hoc	Single Family	Apartments	Mobile Homes	Ad Hoc
Columbus	5	8	6	-	30	94	-	-
Carmine	1	-	2	-	-	-	-	-
Fayetteville	5	-	2	-	-	7	-	-
Flatonia	5	-	2	2	-	-	-	-
La Grange	80	18	15	20	-	-	20	-
Round Top	-	-	-	-	-	-	-	-
Schulenburg	2	-	15	-	30	-	-	-
Giddings	100	80	30	140	-	-	-	-
Lexington	-	-	-	-	-	-	-	-
Brenham	10	15	15	10	100	150	-	20
Burton	1	-	-	-	-	-	-	-
Total	209	111	87	172	160	251	20	20

Source: LCRA, 1984a

Table 3-14
ANNUAL MANPOWER REQUIREMENTS FOR CONSTRUCTION AND OPERATION
CUMMINS CREEK MINE AND FAYETTE POWER PROJECT UNITS 3 AND 4

YEAR	Cummins Creek Mine		Fayette Power Project		Subtotal	Subtotal	Total
	Construction	Operation	Construction	Operation	Construction	Operation	Manpower
1984	6	0	300	0	306	0	306
1985	337	5	600	0	937	5	942
1986	297	58	700	10	997	68	1065
1987	58	329	950	98	1008	427	1435
1988	56	425	800	296	856	721	1577
1989	12	510	250	356	262	866	1128
1990	4	517	0	356	4	873	877
1991	4	513	0	356	4	869	873
1992	12	514	0	356	12	870	882
1993	12	515	0	356	12	871	883
1994	8	531	0	356	8	887	895
1995	4	517	0	356	4	873	877
1996	12	517	0	356	12	873	885
1997	20	516	0	356	20	872	892
1998	8	510	0	356	8	866	874
1999	16	511	0	356	16	867	883

Source: LCRA, 1984a

It is anticipated that local housing sectors would expand to meet in-migration needs. The construction phase should affect temporary housing (i.e., apartments and mobile homes) while the operation work force would affect more permanent, single family housing. Approximately 333 construction workers are presently working on Unit 3 of the FPP, which is approximately 15% complete. These effects constitute a beneficial impact on the housing markets in the four county study area.

3.1.10 Employment

Employment in the four county study area compares favorably with the State of Texas as a whole. Whereas the State unemployment rate increased slightly from 4.8 percent in 1978 to 5.3 percent in 1981, the unemployment rates for the four counties remained stable or decreased for the same period (LCRA, 1984a).

The entire projected peak labor force of 1,577 for the lignite mine and Units 3 and 4 of the Fayette Power Plant is not expected to relocate within the four county study area. Many may already live in the area. Some may in-migrate and others could locate in communities within 100 miles of the proposed project. Also, about 333 construction workers are already presently employed on Unit 3 of the FPP, which is approximately 15 percent complete. These direct employment opportunities constitute major, short-term and long-term, beneficial impacts on available labor forces in and around the four county study area.

In addition to the direct effect of creating jobs, there will also be secondary effects on employment in local communities. Halstead et al. (1983) reported that the growth rate for towns affected by energy developments has been estimated to be from five to ten percent a year. For each construction job at an energy facility, there can be 0.2 to 0.7 additional jobs generated in the local businesses, particularly retail and service oriented sectors. These indirect employment opportunities, resulting from businesses expanding to meet growing local communities demands, constitute an additional, minor, beneficial impact on available labor forces and employment.

3.1.11 Recreation

Within the four county study area, there is a total of 40 parks registered by the Texas Parks and Wildlife Department (TPWD). Of these, nine are privately owned facilities (Table 3-15) and 31 are publicly owned facilities (Table 3-16). The privately owned facilities total 340 acres and the publicly owned facilities total over 15,230 acres. No TPWD registered recreation facilities are within the proposed Cummins Creek Mine area.

Other popular recreational activities include historic sites, museums, lakes, fishing, hunting, and local events (festivals, fairs).

The Fayette County (Cedar Creek) Reservoir constructed by LCRA in 1978 is one of the largest available surface water recreational areas for the surrounding communities. The reservoir is owned and operated by LCRA and public access is controlled through one park. This park, located on the north side of the lake, provides areas for bank fishing,

Table 3-15
CUMMINS CREEK PROJECT
PRIVATE RECREATION AREAS

PARK	COUNTY	ACRES	FACILITIES AVAILABLE FOR:								
			AMPHITHEATRE	BOAT LAUNCH	CAMPING	HIKING	HISTORIC	PICNICING	PLAYGROUNDS	SPORTS	SWIMMING
Lake El Leo	Fayette	19			●						
Festival Hill	Fayette	65	●								
Winedale	Fayette	59	●	●	●		●				
Camp Luther Hill	Fayette	75							●	●	●
Blaha's Overnite	Lee	5			●						
Vernon's Lake	Lee	47			●						
Goerlitz Lake	Lee	37			●						
Lexington Community Park	Lee	8						●			
Nixon Lake	Washington	25			●	●					●
		340									

Source: LCRA, 1984a

Table 3-16

CUMMINS CREEK PROJECT PUBLIC RECREATION AREAS

PARK	COUNTY	ACRES	FACILITIES AVAILABLE FOR: AMPHITHEATRE	BOAT LAUNCH	CAMPING	HIKING	HISTORIC	PICNICING	PLAYGROUNDS	SPORTS	SWIMMING
Attwater Prairie Chicken Refuge	Colorado	7,980									
Columbus Memorial City Park	Colorado	77						●		●	●
Eagle Lake Golf Course & Recreation Center	Colorado	43						●	●	●	
Weimar Youth Baseball Park	Colorado	1.9								●	
Weimar City Park	Colorado	.7						●	●		●
Hill Memorial Park (Weimar)	Colorado	120								●	
Cedar Creek Reservoir (Fayetteville)	Fayette	2,400		●	●						●
Fayette County Fairgrounds (La Grange)	Fayette	83						●		●	
J. C. Park (La Grange)	Fayette	3.7		●	●	●		●			●
Monument Hill State Historical Site (La Grange)	Fayette	80					●	●	●		
Kreische Brewery Site (La Grange)	Fayette	35.9					●				
Flatonia Community Park	Fayette	6.9						●	●		
La Grange City Park	Fayette	3									
La Grange City Park North	Fayette	6						●	●	●	
Schonest Welt Park (Schulenburg)	Fayette	1.9									
Wolther's Park (Schulenburg)	Fayette	19						○	○	○	○

Table 3-16
(continued)

PARK	COUNTY	ACRES	FACILITIES AVAILABLE FOR:								
			AMPHITHEATRE	BOAT LAUNCH	CAMPING	HIKING	HISTORIC	PICNICING	PLAYGROUNDS	SPORTS	SWIMMING
Lake Sommerville Nails Creek Park	Lee	2,800		●	●	●		●			●
Giddings City Park	Lee	11.1						●	●	●	
Lexington City Square	Lee	1.1									
Yegua Creek Park (Lake Sommerville)	Washington	620		●	●	●					●
Rocky Creek Park (Lake Sommerville)	Washington	475		●	●	●		●			●
Overlook Park (Lake Sommerville)	Washington	160		●	●			●			●
Washington County Fairgrounds (Brenham)	Washington	63.6								●	
Linda Anderson Park (Brenham)	Washington	20.6									
Blinn Blvd. Park (Brenham)	Washington	4.1									
Jackson Street Park (Brenham)	Washington	20						●	●	●	
Jerry Wilson Park (Brenham)	Washington	1.8						●	●	●	
Fireman's Park (Brenham)	Washington	29.4						●	●	●	●
Hattie Flowers Park (Brenham)	Washington	5.2						●	●	●	
Little League Fields (Brenham)	Washington	6.4								●	
Washington on the Brazos	Washington	154.1	●				●	●			

Source: LCRA, 1984a

overnight camping, parking and boat launching. The lake's sport fishery includes laregmouth bass, white crappie, channel catfish, blue catfish and sunfishes.

LCRA's Fish and Wildlife Plan (see Biological Resources Section and Appendix D), that would be implemented during reclamation, could result in increased recreational opportunities through improved habitats and wildlife resources within the permit area. The plan includes enhancement of terrestrial vegetation for wildlife, stream reconstruction to help replace fish and wildlife values and pond and reservoir reclamation, including the 800 acre end-lake.

The projected labor force of approximately 1577 workers (and their families), associated with the power plant and mine would place some additional demands on local recreational resources. In addition, local roads will experience an increase in traffic, potentially affecting recreational areas. No existing or proposed recreational land will be directly impacted by mining activities, with the possible exception of individual farm ponds used for fishing or hunting.

3.1.12 Civil Features

In addition to oil and gas pipeline and transportation networks, the proposed Cummins Creek project area also contains a 138 kV electrical transmission line (owned by LCRA), and five private cemetaries (Figure 3-2b). There are no known airports, churches or State historical monuments to be directly affected by the proposed mine, conveyor or Units 3 and 4. All civil features located within the proposed mine area should be relocated in accordance with State mining regulations (RRC, 1983), resulting in minor, short-term, adverse impacts. However, some indirect effects of these relocations (e.g., Bell Cemetary and/or LCRA's 138 kV line) could result in minor or major, short-term or long-term, adverse impacts on certain individuals or families. Potential impacts on the Wilbarger Trace are discussed in Section 3.8, Archeological and Historic Resources.

3.2 PUBLIC HEALTH

Existing Conditions

Statistics on respiratory diseases for the Fayette County area are not available (Texas Department of Health Personal Communication, 1984). Therefore, the existing conditions on public health cannot be described. The health effects of the proposed alternative are projected based upon comparison of emissions and effluents with standards and criteria developed from national public health data. Both regulated and currently unregulated pollutants are evaluated.

Mine Construction And Operation

Air emissions relating to mine construction and operation are described in Section 3.3.2. Table 3-17 summarizes the long-term average concentration of regulated pollutants from mining activities.

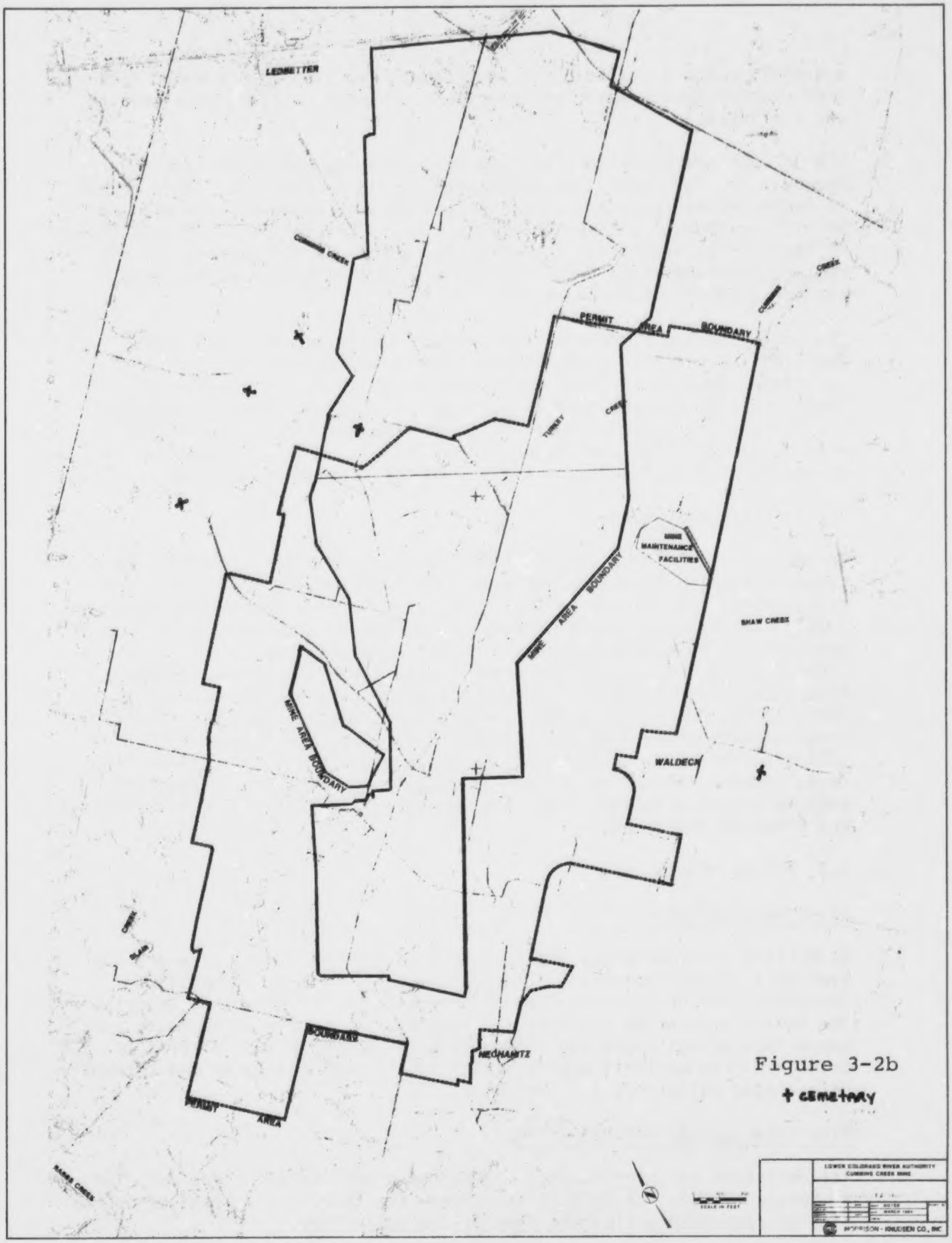

LEDBETTER
CUMMINS CREEK
PERMIT AREA BOUNDARY
CUMMINS CREEK
TURKEY CREEK
MINE MAINTENANCE FACILITIES
MINE AREA BOUNDARY
SHAW CREEK
MINE AREA BOUNDARY
WALDECK
CREEK
BOUNDARY
NECHANITZ
PERMIT AREA
RABBS CREEK
SCALE IN FEET
LOWER COLORADO RIVER AUTHORITY
CUMMING CREEK MINE
NOTED
MARCH 1984
MORRISON - KNUDSEN CO., INC

Figure 3-2b

† cemetary

TABLE 3-17

CUMMINS CREEK MINE
MAXIMUM PROJECTED AIR QUALITY IMPACTS
(ug/M^3)

Pollutant	Annual Background	Maximum Concentration Outside Permit Area Boundary	Total Impact	NAAQS
TSP	32	10	42	75(60)[b]
SO_2	5[a]	Near Zero	5	80
NO_2	22[a]	1	23	100
CO	0	Near Zero	0	--

---

[a] Converted from ppm values standard atmospheric conditions.
[b] Primary (Secondary)

No violation of the primary National Ambient Air Quality Standards (NAAQS) are expected and therefore no determental effect to human health is anticipated. Non-regulated air pollutants associated with suspended particulates would be insignificant.

Overland Conveyor Construction And Operation

Construction and operation of the conveyor are expected to have minor air-quality impacts (See Section 3.3.2). The lignite conveyor was not included in the emissions modeling for the mine because no violations of air quality standards are projected.

Units 3 and 4 Construction and Operation

This section projects health effects of regulated and unregulated air emissions and discharges to surface and groundwater due to the construction and operation of the Fayette Power Project Units 3 and 4. The first discussion evaluates the health effects of pollutants formally regulated by either the Federal or State government. The second discussion evaluates expected pollutants for which a formal regulatory mechanism does not exist.

Regulated Air Pollutants. Air emissions from combustion of lignite in Units 3 and 4 are summarized in the Air Quality Section. The health effects of the regulated pollutants are evaluated by modeling projected ground level concentrations and comparing them to existing standards. These pollutants are known to produce adverse health effects only if threshold concentration levels are exceeded. The EPA has determined the exposure-dependent threshold level (or levels) for each regulated pollutant by a lengthy and complex process. During this process, a primary national ambient air quality standard (NAAQS) was developed based upon the latest scientific evidence available with additional scientific research commissioned, if necessary. Each primary NAAQS was established only after careful evaluation by EPA, an independent panel of scientists and the general public.

The primary NAAQS for regulated pollutants are set at concentrations below the health effects threshold level and include a margin of safety considering the health of especially sensitive persons (e.g., the very young, the aged, and infirm). Possible inadequacies in the scientific evidence on health related effects are also considered in the standard setting process.

Public health is also protected by other air quality regulations such as the secondary NAAQS, Prevention of Significant Deterioration (PSD) rules and emission regulations that ensure the primary NAAQS are never approached in clean air areas like that surrounding the project. There is also a continuous program of review and enforcement by governmental agencies to ensure that public health is protected at all times (see Section 3.3.2). Concentrations for each regulated pollutant projected by the Texas Climatological Dispersion Model (TCDM) are provided in the Table 3-18 including 1) the existing background, including emissions from Units 1 and 2; 2) Unit 3; 3) Unit 4; and 4) the cumulative total for the project area. These concentrations are compared to the pertinent primary NAAQS.

As shown in Table 3-18, TCDM Computer modeling results demonstrate that emissions of particulate matter, sulfur dioxide, and nitrogen oxides from the Units 3 and 4 would not cause adverse public health effects since the expected concentrations of these pollutants should remain well below the NAAQS. Emissions of carbon monoxide and hydrocarbons should also be so low that their impacts would be undetectable.

Non-Regulated Air Pollutants. Some substances emitted to the air are suspected of causing, either directly or indirectly, adverse human health effects but are not formally regulated. This may be due to a lack of scientific evidence relating an air pollutant to a purported adverse effect or to ambient concentrations being so low that they never approach health threatening levels. Also, some pollutants are in the process of having a regulatory mechanism established (arsenic) or are regulated only for specific source (mercury). The health effects of these non-regulated pollutants can be evaluated by comparison to various guidelines shown in Tables 3-19 and 3-20.

The pollutants evaluated were limited to those produced in measurable quantities from the project and possible at ambient concentrations purported to have adverse health effects. These include radionuclides, trace metals and acid deposition (UT and EHA, 1983).

Radionuclides. The radionuclides of concern to evaluation of lignite burning are the natural Uranium-238 (U-238) and Thorium-232 (TH-232) decay series. Through a long series of alpha and beta decays U-238 eventually becomes stable Lead-206 (Pb-206) and Thorium-232 (TH-232) becomes stable Lead-208 (Pb-208).

In evaluation, maximum permissible concentrations (MPC's) recommended by the International Commission on Radiation Protection are used (Table 3-19) for comparison. These concentrations are recommended so that doses to certain critical organs will not exceed a certain number of millirems per year. The limitations were based on observations of early occupational groups who inhaled, or ingested, large quantities

TABLE 3-18

COMPUTER MODELING ANALYSIS OF REGULATED AIR POLLUTANTS

	Primary NAAQS (ug/m^3)		Projected Concentration (ug/m^3)				Cumulative Present NAAQS
Pollutant	Chronic	Acute (hrs.)	Current[1]	Unit 3	Unit 4	Total	
PM[2]	75 annual		30	0.05	0.05	30.1	40
		260 (24)	116	0.30	0.30	116.6	45
SO_2	80 annual		7.8	1.72	1.75	11.27	14
		365 (24)	33.8	10.2	10.2	54.20	15
NO_2	100	N/A	10.0	1.02	1.5	12.52	13
CO[3]		10,000 (8)			8.0		--
		40,000 (1)					--
Ozone[4]		235 (1)					--

---

1. Existing background including emission from Fayette Power Plant Units 1 and 2.

2. PM represents particulate matter.

3. The emission rate was so low modeling was not warranted; projection done by ratioing against SO_2 rates.

4. No projections made because hydrocarbons necessary for ozone formation are emitted well above ground level.

TABLE 3-19

ESTIMATED MAXIMUM ANNUAL GROUND-LEVEL CONCENTRATIONS, AMBIENT BACKBROUND LEVELS, AND MAXIMUM PERMISSIBLE CONCENTRATIONS

Nuclide	FPP Units 3 & 4 Maximum Annual Ground-Level Concentrations (aCi/M^3)	Background Concentrations (aCi/m^3)	Permissible Concentrations (aCi/m^3)
Uranium-238	0.62	100-400	5,000,000
Uranium-234	0.62	100-400	4,000,000
Radium-226	0.72	80-100	2,000,000
Radon-222	780.0	100,000,000- 500,000,000	3,000,000,000
Lead-210	0.74	10,000	8,000,000
Polonium-210	0.74	1,000	7,000,000
Thorium-232	0.28	30	1,000,000
Thorium-228	0.28	30	200,000
Radium-228	0.28	N/A	1,000,000

Source: UT and EHA, 1983.

TABLE 3-20

MAXIMUM AMBIENT GROUND-LEVEL CONCENTRATIONS OF TRACE METALS DUE TO ALL FPP EMISSIONS

	Annual Average Concentrations (ug/m^3)	Most Stringent Air Quality Standard (ug/m^3)
Arsenic	0.000159 ug/m^3	200.00
Beryllium	0.0000051	0.01
Cadmium	0.0000046	0.05
Chromium	0.000067	0.05
Lead	0.000081	1.50
Manganese	0.000187	1.00
Mercury	0.000212	0.01
Nickel	0.000042	0.10
Selenium	0.000071	0.20

Source: UT and EHA, 1983.

of radioactive materials and were later observed to be more prone to cancer than an unexposed but comparable group. MPC's represent acceptable low health risks.

There is no direct way to derive a dose measured millirem (mrem) from the amount of radioactivity of an element measured in picocuries (pCi). One must know the specific radionuclide, its physical and chemical form and its mode of entry into the body.

The potential health effects from stack releases depend upon the nuclide concentration in the lignite, the amount of lignite burned and the amount of fly ash released from the stack. The radionuclide content of the lignite and the annual radionuclide emission rates for FPP Units 3 and 4 are shown in Table 3-21.

The most direct pathway for human exposure is inhalation of radioactive aerosols direct from the power plant exhaust gas plume. Table 3-19 compares the maximum annual average concentrations computed for the releases with normal background levels and maximum permissible concentrations. The combined impact on ambient air concentrations from radioactive emissions from Units 3 and 4 will be negligible.

Foliar deposition and surface water contamination from such emissions should be minimal. Also, pathways such as intake through surface water (Section 3.5) or food (plant or animal) are considered insignificant as compared to the direct route of inhalation (UT and EHA, 1983) and no quantitative estimates of such uptakes were calculated. Most of the metallic radionuclides in the lignite will be contained in the bottom and fly ash after burning. The concentration increase in the ash burning is proportional to the percent ash content of the lignite. However, the releases of radionuclides and radon from an ash body will be considerably less than that of lignite due to the glassy nature of the ash. In addition, the ash and scrubber sludge disposal area would be covered with at least three feet of clay to comply with current Industrial Solid Waste Management Guidelines (TDWR, 1983). Radon emissions are expected to be reduced by approximately 85% due to the clay cover.

The radon emission rate and maximum probable annual average air concentrations at the ash disposal site were estimated with the use of a model developed by Schiager et al., for uranium mill tailings, piles, and emissions.

Under atmospheric stability condition F (Worst case) and wind velocity of 1 m/s, the concentration of radon at the downwind border of the cell is computed to be 11 pCi/m^3, which is well below the MPC of 3,000 pCi/m.

These atmospheric conditions are highly conservative and the value of 11 pCi/m^3 may be regarded as a safe upper estimate of the annual average concentration. This concentration is approximately 2 to 10% of the ambient background (UT and EHA, 1983).

Trace Metals. Trace metals present in the lignite and capable of producing health impacts were selected for a worst case analysis. The

TABLE 3-21

ANNUAL NUCLIDE EMISSION RATES FROM FP UNITS 3 AND 4

Nuclide	Concentrations in the Lignite (pCi/g)	Uncontrolled Throughput[1] (Ci/Y)	Controlled Emission[2] (Ci/Y)
Uranium-238	1.2	7.9	0.0079
Thorium-230	1.2	7.9	0.0079
Radium-226	1.5	10	0.01
Radon-222	1.5	10	10.0[3]
Lead-210	1.5	10	0.01
Poloniun-210	1.5	10	0.01
Thorium-232	0.6	4.0	0.004
Thoriun-228	0.6	4.0	0.004
Radium-228	0.6	4.0	0.004

1. Assuming the mine maximum capacity of 6.6 million tons of lignite/year for FPP Units 3 and 4.

2. Assuming 99.9% fly ash removal efficiency.

3. Assuming no collection of radon gas prior to release to the atmosphere.

Note: The concentrations of Uraniun-238, Radium-226, and Thorium-232 in the Cummins Creek lignite were measured, while the concentrations for the other nuclides were estimated based on the assumption of secular equilibrium with the measured parent nuclides.

Source: UT and EHA, 1983.

maximum ground-level ambient air concentration was projected for all four units using an air pollution dispersion model and worst-case meteorological data provided by the TACB. Coincidence of maximum concentrations from all four units was assumed (Table 3-20). The annual release of each element was also estimated based upon an annual fuel consumption of 5.25 million tons for Unit 3 and 4.25 million tons for Unit 4 (Table 3-22).

Acute exposures and levels causing acute intoxications were not anticipated due to emission rates and plume dispersion characteristics. Average levels in the lignite and annual average levels in air were therefore used in the trace metal analysis. Also, the assumption was made that the metals present in the lignite will distribute homogeneously in solid materials generated by combustion with no segregation by particle size. The collection efficiency for the lignite-burning units was assumed to be 99.9% for all metals except mercury for which 68.0% was assumed because it forms more volatile derivatives.

Impact evaluation (Table 3-20) was done by comparing the resulting worst case ambient air concentrations for all metals except beryllium and lead with Threshold Limit Values. These values were developed by the American Conference of Governmental Industrial Hygienists to protect workers within the confines of their work environment. Beryllium was compared to its national emission standard (NESHAPS) a more stringent criteria. Lead was compared to its national ambient air quality standard (NAAQS) which is also a more stringent criteria.

As shown in Table 3-20, the maximum ambient ground-level concentrations due to all emissions from the Fayette Power Plant are far below the most stringent air quality standard. Further, the exposure represented by these estimated ambient air levels is far below current contacts through air or diet.

The percentage increases in emissions of trace metals from the operation of FPP Unit 3 relative to current releases from coal-fired units will be less than 6% for all metals considered other than beryllium and manganese (Table 3-22). For these latter metals, the ambient air concentrations may be expected to double by virtue of an approximate doubling in emissions (UT and EHA, 1983). The percentage increase in emissions of trace metals from the operation of Unit 4 relative to releases from the first three units will be less than 6% for all metals considered other than beryllium and manganese which are (44 to 45%), respectively. All ambient air concentrations will remain far below any levels necessitating concern. Therefore, no adverse effects on health are expected on either a short or long-term basis (UT and EHA,1983).

Acid Deposition. Acid deposition is a complicated issue involving considerable debate on the collection and interpretation of monitoring data, environmental effects and cause and effect relationships (See Section 3.9).

TABLE 3-22

TRACE METAL EMISSION INCREMENTS FROM FPP UNITS 3 AND 4 RELATIVE TO WORST CASE EMISSIONS FROM OTHER FPP UNITS[1]

Element	FPP-1+2	FPP-3	Emissions, Tons/yr[2] FPP-1 + 2 + 3	FPP-4	FPP-3 Percent Increment Over 1 & 2	FPP-4 Percent Increment Over 1, 2 & 3
Arsenic	1.931	0.069	2.000	0.056	3.6	2.8
Beryllium	0.018	0.022	0.040	0.0179	122.2	44.8
Cadmium	0.057	0.001	0.058	0.0009	1.8	1.6
Chromium	0.994	0.039	0.833	0.032	4.9	3.8
Lead	0.737	0.055	0.992	0.0442	5.9	4.5
Manganese	0.690	0.809	1.499	0.655	117.2	43.7
Mercury	<2.272	0.235	<2.507	0.1904	10.03	7.6
Nickel	0.483	0.028	0.511	0.023	5.8	4.5
Selenium	0.909	0.010	0.919	0.008	1.1	0.9

---

[1] This table is adapted from Table 4-9 of the earlier study by UT and EHA. The "worst case" philosophy applied in that earlier study for each element has been maintained. Firing rates and collection efficiencies assumed are found in the addendum to the 1982 Study (UT and EHA, 1983).

[2] Emissions are based on coal-firing in Units 1 and 2 and lignite-firing in Units 3 and 4.

3.3 CLIMATE AND AIR QUALITY

3.3.1 Climate

Existing Conditions

The sub-tropical climate of south central Texas is dominated by on-shore movement of warm, moist, unstable maritime air masses from the Gulf of Mexico. From April through September, this results in warm temperatures and frequent thunderstorms of short duration. Sunny days are common. From October through March, cooler air masses from the north frequently wedge in under the maritime air, resulting in cooler, cloudier days and less intense but lengthier rainfalls. These inversions normally last less than a week but are often accompanied by strong winds and sharp drops in temperature.

In spite of cold air outbreaks from the north, all monthly prevailing wind directions are from the south, as measured at Austin. Average wind speeds range from eight miles per hour in September to eleven miles per hour in March. Sustained high winds are normally associated with winter cold fronts, the extreme being 51 miles per hour from the north as averaged over a one hour period at Austin. Wind data collected at the Fayette Power Project since 1977 show a similar pattern.

Temperature, humidity, occurrence of fog and evaporation rates are typical of a warm climate with moderate rainfall. Mean daily temperatures range from the upper 40's in January to the middle 90's in July, measured in degrees Fahrenheit. Below freezing temperatures occur less than 15 days per year on the average. The typical frost-free period is from early March to late November, giving a growing period of nearly nine months. Relative humidities are generally between 50 and 90 percent. Fog resulting in visibilities of less than one-quarter mile occur 25-30 days per year, mostly in the winter months. Mean annual Class A pan evaporation is about 80 inches.

Precipitation is fairly evenly distributed throughout the year, though individual rainfall events and annual averages are highly variable, and the most intense storms occur in summer. The Cummins Creek area has an annual precipitation on the order of 40 inches per year; specific estimates range from 38 to 44 inches, depending on the stations and periods considered.

More detailed climatic data will be presented as necessary for evaluation of particular impacts. All data are based on regional information contained in National Weather Service Technical Publications, adjusted as appropriate to reflect data from stations in the vicinity of the proposed project.

Project Impacts

No measurable impacts to climate are anticipated. Much speculation and theorizing has occurred as to the cumulative impacts from burning fossil fuels such as lignite, but little agreement exists. Climate remains a fairly unpredictable phenomenon on a global scale. Possible impacts of most noted concern are: 1) cumulative, area-wide health effects from fine particles which are not captured by emission control devices; and

2) an increase in acid rain. Health effects are discussed in Section 3.2. Acid rain is discussed in Section 3.9.

3.3.2 Air Quality

Existing Conditions

Except as noted, information on air-quality conditions is taken from LCRA (1984e) and EPA (1979b). From October 1977 to July 1983, LCRA operated three ambient air-quality monitoring stations in the vicinity of the Fayette Power Project (FPP). Station locations are shown on Figure 3-3. In July 1983, monitoring sites 2 and 3 were removed and site 1 was relocated approximately 1.5 miles north of its mapped location. Air-quality parameters monitored included sulfur dioxide, nitrogen oxides and total suspended particulates (TSP). Some meteorological data also are collected.

Table 3-23 lists Texas Air Control Board (TACB) and National Ambient Air Qualtity Standards (NAAQS), along with the annual mean and maximum values of sulfur dioxide, nitrogen dioxide and TSP measured at the three FPP monitoring stations from October 1978 to September 1982. The 1978 data reflect baseline air-quality conditions for rural central Texas. FPP Unit 1 was put into operation in June 1979, while FPP Unit 2 began operation in June 1980. The monitoring data for 1979-82 include the effects of emissions from these units.

National Ambient Air Quality Standards (NAAQS) were established by EPA to define the levels of air quality necessary, with an adequate margin of safety, to safeguard human health and protect the public welfare. The data indicate sulfur dioxide existing ambient air quality levels are less than one-tenth of the NAAQS. The measured nitrogen dioxide ambient levels are approximately 25 percent of the primary ambient air-quality standards. TSP levels are well below the annual geometric mean and 24-hour primary standards. A comparison of measured particulates and sulfur dioxide to the TACB standards shows both to be well below allowable limits, except for particulate readings which reflects dust storm or other unusual conditions. The data obtained since FPP Unit 1 and Unit 2 began operation indicate that, for the primary air pollutants monitored, there has been no significant impact on air quality in the area.

Available data for the Fayette vicinity are insufficient to quantify site levels of carbon monoxide (CO) and ozone. However, CO levels are assumed to be well below standards because levels measured in Austin, where there is a much greater concentration of CO emission sources, are below standards. Ambient levels of ozone have been assumed to be within standards, again because the Austin area is within attainment status for ozone. However, violations of ozone standards are known to occur even in very remote areas as a result of long-distance transport.

The information now available is consistent with LCRA's predictions as presented in EPA (1979b) with respect to the dispersive capacity of the atmosphere in the vicinity of the proposed action. The predictions were based on surface and upper-air weather data from National Weather Service stations in the area, and on previous studies. Data regarding frequency

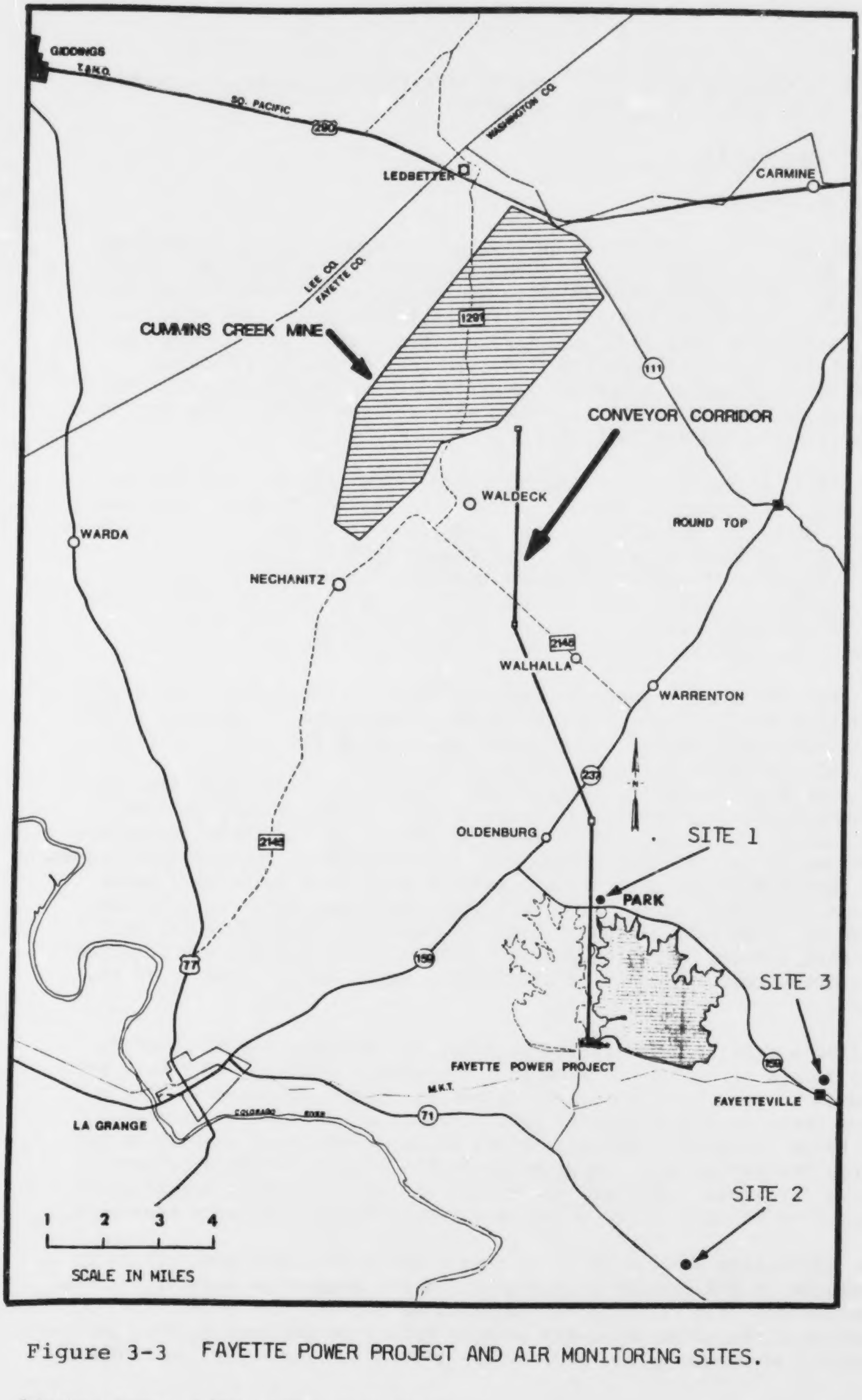

GIDDINGS
T&N.O.
SO. PACIFIC
290
WASHINGTON CO.
LEDBETTER
CARMINE
LEE CO.
FAYETTE CO.
1291
CUMMINS CREEK MINE
111
CONVEYOR CORRIDOR
WALDECK
ROUND TOP
WARDA
NECHANITZ
2145
WALHALLA
WARRENTON
237
N
OLDENBURG
SITE 1
PARK
2145
77
159
SITE 3
FAYETTE POWER PROJECT
159
M.K.T.
FAYETTEVILLE
LA GRANGE
COLORADO RIVER
71
SITE 2
1 2 3 4
SCALE IN MILES

Figure 3-3 FAYETTE POWER PROJECT AND AIR MONITORING SITES.

Adapted from: LCRA, 1983a and 1984c.

TABLE 3-23. NATIONAL AMBIENT AIR QUALITY STANDARDS (NAAQS) AND MAXIMUM MEASURED VALUES OF PRIMARY AIR POLLUTANTS AT THE FPP AIR MONITORING SYSTEM, OCTOBER 1978 - SEPTEMBER 1982.

Definitions of federal ambient air quality primary and secondary standards are as follows. Primary standards define levels of air quality which the U.S. Environmental Protection Agency's (EPA) Administrator judges necessary to protect the public health with an adequate margin of safety. Secondary standards define levels of air quality which the EPA Administrator judges necessary to protect the public welfare from any known or anticipated adverse effects of a pollutant.

Primary Air Pollutants	NAAQS Primary Standards	NAAQS Secondary Standards	TACB Standards	FPP MAXIMUM MEASURED VALUES 1978	1979	1980	1981	1982
Sulfur Dioxide, ppm								
1. Annual Average	0.03	-	-	0.001	0.002	0.003	0.001	0.002
2. 24-Hour	0.14[a]	-	-	0.006	0.007	0.011	0.005	0.011
3. 3-Hour	-	0.05[a]	-	0.016	0.021	0.033	0.016	0.023
4. 30-Minute	-	-	0.4	-	-	-	-	-
Total Suspended Particulates, ug/m^3								
1. Annual [d]	75	60	-	33	30	41	40	34
2. 24-Hour	260	150	-	146[b]	136	127	136	126[c]
3. 5-Hour	-	-	100	-	-	-	-	-
4. 3-Hour	-	-	200	-	-	-	-	-
5. 1-Hour	-	-	400	-	-	-	-	-
Nitrogen Dioxide, ppm								
1. Annual Average	0.05	0.05	-	0.008	0.014	0.013	0.008	0.009

a. Not to be exceeded more than once per year.
b. Dust storm conditions produced a value of 171 ug/m^3.
c. This excludes one value of 180 ug/m^3 which is believed to have been influenced by the eruption of Mt. Chichon.
d. Geometric mean.

Sources: LCRA, 1983a; 1984e.

distributions of wind speed, direction and atmospheric stability indicate a fairly high frequency of occurrence (17-24 per cent) of stable conditions and lower air movement, which would tend to keep an elevated power plant stack plume at least at discharge height. The levels at which plume constituents are most effectively mixed with the surrounding atmosphere range from near the top of the stacks (459 feet on winter mornings) to over 2000 feet above the stacks (on summer afternoons).

However, there also is a relatively high frequency (15-20 per cent) of unstable conditions, during which an elevated plume would be mixed more readily toward the ground. This potential for groundward movement, combined with the high frequency of surface air movement to the north (refer to Section 3.3.1), was thought to be conducive to the concentration of any air-quality impacts to the north of the proposed action. Inversion conditions, which trap pollutants near the ground, are infrequent in the study area (Hosler, 1961). As a result, air normally moves upward from the stacks to the mixing zones. The principal potential for groundward movement of the plume is in winter (November-February), when inversions occur during 35 per cent of total hours. This would be the period when any air-quality impacts would be most pronounced.

Mining Impacts

Several dust producing activities affecting air quality are associated with mine construction and operation. Activities such as truck traffic on dirt and gravel roads, overburden removal and wind erosion of exposed areas will cause suspension of soil particles. Other activities, such as lignite removal, breaking, conveying and stockpiling, will result in the generation of fine lignite particles. Air quality relating to these different particle types is measured in terms of total suspended particulates (TSP).

Mine construction and operation will also require the use of large diesel trucks and earth moving equipment as well as gasoline-powered vehicles. Air contaminants from vehicle exhaust will include sulfur dioxide, nitrogen oxides and carbon monoxide. Several other exhaust pollutants are emitted in insignificant quantities, including lead, hydrocarbons and carbon dioxide (LCRA, 1984a).

The emission rates for each source of dust and exhaust from mine construction and operation have been quantified based on established emission factors, estimated control factors and mine design data (LCRA, 1984e). Based on the resulting calculations of annual emissions, the maximum impact would occur in mining year 9.

LCRA utilized the Texas Climatological Model (TCM) to compute major pollutant concentrations for the worst-case year. TCM calculates long-term average concentrations downwind from point and area sources of pollution. The model incorporates background air-quality data, wind data and emission sources. Concentration calculations were made in the mining area and at distances up to 5 miles away. The results of the model are presented in Table 3-24.

Although particulate concentrations within the mining area will be high (up to 200 micrograms per cubic meter in the lignite removal and over-

TABLE 3-24. MAXIMUM PROJECTED AIR QUALITY IMPACTS FROM THE CUMMINS CREEK MINE (ug/m^3)

Pollutant	Annual Background[c]	Maximum Concentration Outside Permit Boundary	Total	NAAQS
TSP	32	10	42	75 (60)[b]
SO_2	5[a]	Near zero	5	80
NO_2	22[a]	1	23	100
CO	0	Near zero	0	--

a. Converted from ppm values, standard atmospheric conditions.
b. Primary (secondary).
c. Concentrations based on monitoring by LCRA.

Source: LCRA, 1984e.

TABLE 3-25. ESTIMATED MAXIMUM EMISSION RATES FOR ALTERNATIVE LIGNITE TRANSPORTATION SYSTEMS

	Total Emission Rate (tons per year)	
Alternative	Particulate Matter	Nitrogen Oxides
Private Electric Rail	0.015 [a]	0.0
Conveyor	0.123 [a]	0.0
Private Diesel Rail	4.40 [a,b]	63 [b]
Commercial Diesel Rail	8.83 [a,b]	131 [b]
On-Highway Diesel Haul Truck		
Dusty Paved Roads	85,620 [a]	236 [b]
Other Paved Roads	28,540 [a]	236 [b]

a. This emission rate is based on an emission factor from Fugitive Emissions from Integrated Iron and Steel Plants, EPA-600/2-78-050, March 1978, and the site-specific emission factors.

b. This emission rate is based on an emission factor from Compilation of Air Pollution Emission Factors, 3rd ed. AP-42, EPA, 1977, and the site-specific emission factors.

Source: LCRA, 1984a.

burden spreading areas), most particles will settle out quickly. The maximum TSP concentration increase outside the permit boundary is estimated at 10 micrograms per cubic meter and occurs up to 1000 feet outside the boundary. Increases in sulfur dioxide, nitrogen dioxide and carbon monoxide from mining activities are projected to be negligible. No violations of federal air quality standards are expected to occur.

The TACB currently exempts lignite mines from permit requirements because of the insignificant quantity of particulate emissions from such mining operations (LCRA, 1983a). The TACB will require a construction permit for the feeder/breaker and conveyor system because this equipment is defined as fuel processing equipment.

Although not subject to permit specifications, LCRA proposes a dust control program which will include the following measures:

- watering haul roads and service roads
- minimizing drop heights for excavators within normal operating limitations of machine
- posting road speed signs and maintaining road speeds at low to moderate levels
- covering conveyor systems
- enclosing transfer stations for conveyor at power plant and mine
- minimizing haul lengths
- utilizing vegetation to minimize blowing dust (revegetating stockpiles, recontoured areas).

Based on limited field inspection of the lignite mine associated with the Gibbons Creek Project 50 miles northeast of Cummins Creek, these mitigation measures should provide substantial control of fugitive dust emissions.

Conveyor

Emission rates for the conveyor system and alternative lignite transportation systems are provided in Table 3-25. Construction and operation of the conveyor are expected to have minor air-quality impacts. Normal construction-related impacts are wind erosion from cleared terrain, excavations, and dust and exhaust from vehicular activity. Operation of the electric-powered conveyor will produce lignite dust, though in relatively small quantities. Inspection of the conveyor at the Gibbons Creek power plant indicates the principal problems occur at transfer stations, and are minor. At Cummins Creek, the current proposal is to utilize a curved conveyor which would eliminate the two transfer stations previously proposed.

The lignite conveyor was included in the TSP inventory but not included in the emissions modeling for the mine because conveyor emissions were considered to be negligible. No violation of air quality standards is projected. Mitigating factors include the high moisture content of the lignite, the enclosed design of the conveyor and its fairly slow speed (approximately 9.7 miles per hour).

Power Plant

Potential sources of pollution from construction and operation of Units 3 and 4 at the Fayette Power Plant include construction activities, in-plant materials handling and power plant boiler emissions. Analysis of these effects is provided in LCRA 1982, 1983a, 1984b and 1984c; the analysis for Unit 3 has been accepted by TACB, through issuance of an operating permit (PSD-TX-486, January 24, 1984).

Construction impacts will be localized at the existing plant site, and will include wind erosion from disturbed terrain, excavations and dust and exhaust from vehicular activity. Most terrain-disturbing construction for Units 3 and 4 has already been completed (foundation and piping excavations for Unit 3, and ash handling areas for both units). Pending construction for Unit 4 will entail foundation excavation and erection of the boiler facilities.

Materials handling impacts relate to lignite, limestone and ash handling. Emissions from in-plant fuel handling will be from stockpiles, conveyors and transfer operations. Control facilities include covered conveyors and baghouses; these will minimize particulate emissions from the fuel handling system. Consequently, particulate impacts from the in-plant fuel facilities are projected to be insignificant.

Limestone handling involves emission sources similar to those for the lignite handling system. The potential emission points include the limestone unloading and conveyor feed systems and transferring operations to and from the stockpile. Particulate emissions will be mitigated through wet sprays and covering of the active storage pile.

Fugitive emissions from the in-plant fuel and limestone handling facilities are primarily large diameter particulates which will settle out quite rapidly. Several lignite handling systems have been operating in Texas for as long as 30 years. Investigations have shown that the fugitive emissions from these sources do not create a nuisance and emissions do not effect areas beyond the property line of the facility.

Fly ash handling facilities will consist of a vacuum-operated ash collection system and a pressure-operated ash transport and storage system. After separation from the transport air, ash will be filtered through a baghouse. The exhaust from the baghouse will then pass through vacuum pumps before being discharged to the atmosphere. Each of the two ash storage silos will be equipped with a dry ash loading spout. A flexible outer covering with an exhauster fan will be provided to pull dust and dirty air up from around the loading spout. This air will be discharged into the storage silo. Additionally, a wet unloading mixer will be provided under each silo; these systems will mix water with fly ash to eliminate dust.

Boiler emissions will occur from the two lignite-fired steam electric generating units to be placed adjacent to the two existing coal-fired units at the Fayette Power Project. Proposed Units 3 and 4, will be designed to burn, exclusively, Texas lignite mined from sources of the type described in Table 3-62.

LCRA intends to burn a blended coal mixture of up to 10% lignite in FPP Units 1 and 2. No physical modifications will be necessary to the units to accommodate the blended fuels (LCRA, 1983c). The allowable limits on emissions will be unchanged. However, the use of lignite is expected to increase emissions to levels closer to the permit limits (TACB, 1984).

With respect to Units 3 and 4, boiler emissions of primary interest include nitrogen oxides, sulfur dioxide and particulate matter; in addition to the ambient standards (NAAQS), two sets of point source standards apply to the units: NSPS and PSD.

The new boiler emissions are subject to the revised Federal Standards of Performance for New Stationary Sources (NSPS) contained in 40 CFR 60 Subpart Da. This regulation sets specific emission limits for particulate matter, SO_2, NO_x and plume opacity for fossil-fuel-fired steam generators. In addition, the Texas Air Control Board regulations will apply. The applicable emission limitations are presented in Table 3-26.

The Prevention of Significant Deterioration (PSD) program requires clean air areas of the country to maintain and protect their clean air. PSD increments have been established for two parameters -- SO_2 and TSP. (Table 3-27). These increments define the maximum increases in ambient air pollution levels allowed in a given area. The existing level of air pollution for the area (referred to as the PSD baseline level) is determined at the time the first new pollutant source applies for a PSD permit. The determination is made using both monitored ambient air-quality data and computer modeling. Once the baseline is established, future ambient air pollution is limited to a maximum level defined as the sum of the PSD baseline plus the PSD increment. If this sum is greater than NAAQS, the NAAQS is used as the limiting maximum level. Thus, the combined ambient impact of all new pollutant sources must be less than the allowed PSD increment.

The PSD regulations have the effect of protecting clean air in rural areas, by preventing emissions which could cause pollution up the NAAQS level. In most rural areas, such as Fayette County, the baseline level is so low that, even if all of the PSD increment were to be consumed, future ambient air pollution levels will always be well below both primary and secondary NAAQS. In such areas, the PSD increments indirectly protect public health by providing a third margin of safety in addition to that provided by the primary and secondary NAAQS.

With regard to the proposed projects, the PSD regulations apply to air pollution sources where emissions exit through a well-defined vent or stack and to fugitive emissions from select industrial categories. Fugitive emissions from the in-plant lignite and fly ash handling systems associated with Units 3 and 4 are covered under the PSD regulations. At this time, fugitive emissions, such as those generated at the Cummins Creek Mine, are not regulated by the PSD program. Using monitoring site 2 as representative of background levels of the ambient air quality, PSD baseline levels and PSD increments have been established for the Fayette Power Project as follows:

TABLE 3-26. NEW SOURCE PERFORMANCE STANDARDS (NSPS) EMISSION LIMITATIONS APPLICABLE TO FPP UNITS 3 AND 4

	Federal Limitations	State Limitations
Nitrogen Oxides	0.6 $lb/10^6$ BTU	None
Sulfur Dioxide	90% Removal[a]	3.0 $lb/10^6$ BTU
Particulates	0.03 $lb/10^6$ BTU	0.3 $lb/10^6$ BTU
Opacity	20%	
	27%[b]	20%[c]

a. This value represents the sulfur dioxide NSPS promulgated June 11, 1979, based upon firing lignite with an uncontrolled emission rate of less than 12.0 lb. sulfur dioxide per million BTU of heat input.

b. For not more than one six minute period in any hour.

c. For not more than one five minute period in any hour.

Source: LCRA, 1982.

TABLE 3-27. PREVENTION OF SIGNIFICANT DETERIORATION ALLOWABLE AIR QUALITY INCREMENTS FOR SO_2 AND TSP

All values in ug/m^3

		ALLOWABLE AIR QUALITY INCREMENTS		
Pollutant	AVERAGING TIME	CLASS I	CLASS II[a]	CLASS III
Sulfur Dioxide	Annual Mean	2	20	40
	24-Hour	5	91	182
	3-Hour	25	512	700
Total Suspended Particulates	Annual Mean	5	19	37
	24-Hour	10	37	75

a. The FPP area is classified as a Class II area.

Source: LCRA, 1982.

	Baseline	PSD increment
3 hr. - SO_2	60 ug/m^3	512 ug/m^3
24 hr. - SO_2	23 ug/m^3	91 ug/m^3
Annual SO_2	5.3 ug/m^3	20 ug/m^3
24 hr. - Particulate	84 ug/m^3	37 ug/m^3
Annual - Particulate	32 ug/m^3	19 ug/m^3

With these standards in mind, it is appropriate to identify and characterize the impacts of the boiler emissions from FPP Units 3 and 4. Units 3 and 4 each utilize a pulverized lignite-fired boiler with a gross generating capacity of 451 megawatts. The boilers are tangentially designed to control formation of NO_x emissions. An electrostatic precipitator (ESP) will be used to remove in excess of 99.954% of the particulate emissions in the boiler exhaust. A limestone slurry SO_2 scrubber system will remove 90% of the SO_2 formed in lignite combusion. These control measures will allow the boilers to meet all applicable NSPS standards (LCRA, 1982; LCRA, 1984c). At maximum capacity, the maximum emission rates expected are as follows (LCRA, 1983a; LCRA, 1984g).

Parameter	Unit 3	Unit 4
SO_2	4,735 lb/hr	5,105 lb/hr
NO_2	2,820 lb/hr	3,063 lb/hr
Particulates	142 lb/h4	153 lb/hr
Opacity	less than 20%	less than 20%
Mercury	-	0.027 lb/hr
Beryllium	0.00945 tons/yr	0.00128 lb/hr

Emissions from the power plant will exit through 533 foot chimneys and be dispersed in the ambient air. An analysis of the ambient air-quality effects of the power plant emissions was undertaken by LCRA as part of the PSD permit application. Separate models were run for Units 3 and 4. The results are shown in Table 3-28, in terms of the cumulative PSD effects of all four FPP units.

TABLE 3-28. PROJECTED EMISSIONS OF FPP
UNITS 1 THROUGH 4 ON PSD REQUIREMENTS

Pollutant	FPP Emission Levels	PSD Allowable Increment	Federal Standard
Sulfur Dioxide, ug/m^3			
1. 3-Hour	225*	512	1300
2. 24-Hour	55*	91	265
3. Annual	7*	20	80
Particulates, ug/m^3			
1. 24-Hour	2.5	37	260
2. Annual			

Sources: LCRA, 1982 and 1984g.

*Based of PSD analysis conducted by TACB for Unit 4 (PSD-TX-635).

The modeling indicates that the FPP units, coupled with other significant sources in the area, will use less than half the allowable PSD increment for SO_2 and particulates. Modeling also predicts that ambient air quality in the FPP area will meet the NAAQS. Thus, the impacts of the power plant are within acceptable limits.

A more complete analysis of the power plant and mine control equipment, actual emission estimates and dispersion modeling has been filed with the Texas Air Control Board as part of the TACB construction and PSD permit applications. The TACB and EPA have completed the evaluation of the PSD permit application for Unit 3, the lignite mine and conveyor system. Permit PSD-TX-486 for Unit 3, as well as associated transfer points, coal handling and limestone handling equipment, has been issued effective January 24, 1984.

TACB is in the process of reviewing LCRA's permit application for Unit 4. The analysis for Unit 4 indicates that the proposed source will not cause or contribute to a violation of the NAAQS or exceed the allowable PSD increment. Review of the PSD application shows that LCRA will employ Best Available Control Technology and there will be no significant adverse impacts on soils, vegetation, visibility or any Class I area. TACB, based on their review of the PSD application, has recommended a preliminary determination of approval for the proposed Unit 4. Adequate public participation will be allowed for before any final permit of approval is granted.

3.4 SOUND QUALITY

Existing Conditions

Generally, increases in noise levels from those experienced in wilderness areas, to rural areas, and finally to busy metropolitan areas, are directly related to man and machines. Outside daytime residual noise levels at a remote wilderness site would be around 16 dBA. In comparison, the same noise level would range between 30 and 40 dBA on a farm and between 60 to 70 dBA in the city (EPA, 1971a).

Within the Cummins Creek surface mine study area, cattle production is the major agricultural activity. Almost all cleared land is devoted to livestock with oil and gas activity second. Noise monitoring was conducted at 17 sites within this rural area to establish baseline noise levels. The average noise level (Ldn) for the mine study area was 53.7 dBA.

Land use in the overland conveyor study area is similar to that of the mine study area (i.e., agricultural/livestock production), but has more oil and gas development and less gravel mining. Noise monitoring was conducted at 32 sites within the overland conveyor study area. The average noise level (Ldn) for the conveyor study area was 57 dBA.

Basically, an average outdoor residual noise level will remain constant if the land use does not change. However, if the land use changes, the outdoor noise residual level may increase 10 dB or more. At many locations, maximum noise levels have increased because of the addition of new intruding noise sources such as an electric power plant, a freeway, and/or a jet airport (EPA, 1971a).

There are many sources of operational noise associated with the existing Fayette Power Project Units 1 and 2. In addition, the site preparation work on Unit 3 now underway contributes to the existing noise levels. Also, the cooling pond circulating water pumps, the make-up water pumps, and switchyard transformers and related electrical equipment, are additional sources of noise. Table 3-29 and Figure 3-4 present the existing ambient noise levels and locations calculated for the Fayette Power Project. The total noise data for the mine and conveyor study areas were also collected and analyzed. Two categories of average noise levels (Ldn) were calculated, one for relatively quiet areas (46 dBA), and other for average highway noise (67 dBA). Supplemental information is included in Appendix C.

Projected Effects and Model Results

Lignite Mine

Equipment would be utilized in varying degrees over the total life of the surface lignite mine. This equipment with its associated activities will produce noise. The proposed mining activity can be divided into three phases. Phase one is the initial three years prior to actual mining and involves the installation of site facilities and erection of the first BWE and dragline, plus support equipment. Phase two is the production phase, which would occur over 37 years and includes the ongoing process of mining and reclamation. Phase three involves final reclamation and is to be performed by a dozer/scraper fleet. During the last phase, the facilities and major equipment are also dismantled and/or removed. Table 3-30 presents an overview of the major equipment needs based on these three operational phases of the proposed mine.

Overland Conveyor

Noise would result from graders, trucks and other equipment used during construction of this system. Also, operation noise would result from the conveyor belt running on idlers. The majority of the conveyor system would be covered or enclosed to reduce noise and control particulate emissions. The conveyor is designed to be operated 16 hours a day, 5 days a week, and 50 weeeks a year for the life of the mine.

Units 3 and 4

Adding these additional units would basically double the sources of noise at the power plant block. In addition to the construction phase, estimated to last 2-3 years, this would include equipment such as fans, gear drives, motor drives, control valves, pipelines, exhaust ducts, relief valve stacks and related operational processes. The power block is expected to be operational 24 hours a day, 365 days a year, at an annual capacity factor of 85 percent.

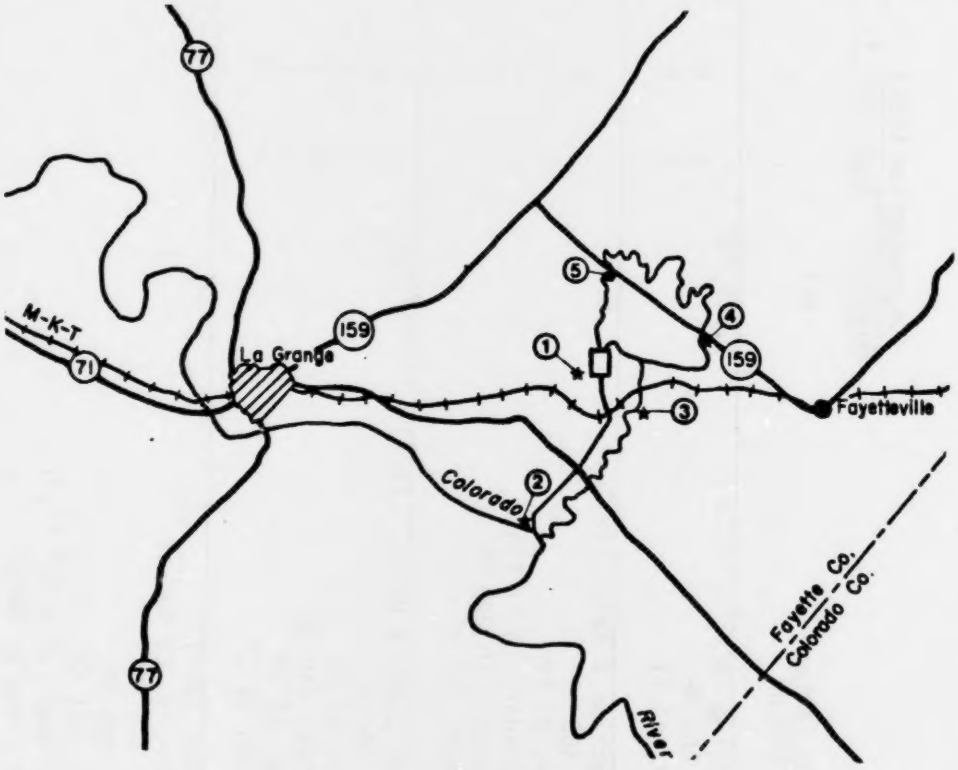
A mathematical (computer) model was used to simulate operation and calculate noise levels at different distances from the mine conveyor (See Appendix C). To simulate the proposed activities and predict mine noise levels off-property, inventories of noise sources for the mine and conveyor were developed (Tables 3-31 and 3-32, respectively) and the locations of nearby sensitive receptors (e.g., schools, churches,

TABLE 3-29
EXISTING AMBIENT NOISE LEVELS AT FPP

Location (See Fig. 3-4 below).		Existing Noise Level (Ldn)
No. 1	Cooling lake intake	69
No. 2	River intake	64
No. 3	Nearest occupied residence to power plant	60
No. 4	Nearest occupied residence to cooling lake	59
No. 5	Closest approach to plant site	68

Figure 3-4

NOISE SAMPLE LOCATIONS AT FAYETTE POWER PROJECT


77
M-K-T
71
La Grange
159
⑤
④
①
159
③
Fayetteville
②
Colorado
Fayette Co.
Colorado Co.
77
River

Source: EPA, 1979b

Table 3-30

CUMMINS CREEK PROJECT
TASK QUANTITIES & EQUIPMENT REQUIREMENTS BY MINE PHASE[a]

Equipment	Preproduction Phase Quantity	Preproduction Phase Avg.	Preproduction Phase Max #	Production Phase Quantity	Production Phase Avg.	Production Phase Max #	Post-Production Phase Quantity	Post-Production Phase Avg.	Post-Production Phase Max #
Site Clearing (Acres)	953			8,633			-0-		
Dozer, 460 HP		2	3		1	2			
Topsoil Handling (BCY)[b]	1,989,532			18,291,814			949,354		
Dozer, 460 HP		2	4		2	4		2	3
Scraper, 44 CY		5	8		5	10		3	7
Road Construction & Maint. (miles)	6.8			270.3			-0-		
Dozer, 460 HP		1	2		1	2		1	1
Scraper, 44 CY		2	4		2	5		1	1
Motor Grader, 16 Ft Blade		2	2		2	3		1	1
Water Wagon, 10,000 Gal.		2	2		2	3		1	1
Compactor, 310 HP		1	1		1	1		1	1
Water Control Const & Maint. (BCY)	737,559			14,062,241			3,154,934		
Dozer, 460 HP		1	2		2	2		1	2
Scraper, 44 CY		2	4		2	2		2	3
Compactor, 310 HP		1	1		1	1		1	1
Backhoe, 15 CY		1	1		1	1		1	1
Dragline, 3½ CY		0	0		1	1		1	1
Burden Removal (BCY)	-0-			2,030,428,000			18,542,000 (End Lake)		
Dragline, 90-CY Bucket					2	2		0	0
Dozer, 460 HP					5	5		3	3
Dozer, 700 HP					3	5		0	0
Loader, 12½ CY					1	1		0	0
Bucket Wheel 20 x 10^6 CY/Yr					2	2		1	1
Mobile Transfer Conveyor					3	3		1	1
Hopper Car					2	2		1	1
Cable Reel Car					2	2		1	1
Tripper Car					2	2		1	1
Spreader Car					2	2		1	1
Around-the-Pit Conveyor System					2	2		1	1

Table 3-30
(Continued)

Equipment	Preproduction Phase			Production Phase			Post-Production Phase		
	Quantity	Avg.	Max #	Quantity	Avg.	Max #	Quantity	Avg.	Max #
Lignite Recovery (Tons)	-0-			221,280,000			-0-		
Continuous Surface Miner					3	3			
Dozer, 460 HP					2	2			
Front-End Loader, 12½ CY					1	1			
Backhoe, 16 CY					1	1			
100 Ton Trucks					11	16			
32,800 LF Mine Conveyor					1	1			
63,000 LF Overland Conveyor					1	1			
Reclamation & Revegetation (Acres)[c]	-0-			8,799			820		
Dozer, 700 HP					2	2		2	6
Scraper, 44 CY					1	1		1	1
Motor Grader, 16 Ft Blade					1	1		1	1
Revegetation Fleet					1	1		1	1

---

[a] These figures do not reflect support equipment, only those equipment primarily utilized for each task operation.

[b] Topsoil-handling volumes include stockpiling and rehandle, where appropriate.

[c] Reclaimed acreage includes surface water control structures which will be built on reclaimed land, then reclaimed a second time. Total disturbed acreage is 9,586.

Table 3-31
CUMMINS CREEK PROJECT
NOISE SOURCE INVENTORY
MINE OPERATIONS -- YEAR 8

Source Numeric Identification	Noise Sources Present	Source Location East[a] X (km)	Source Location North[a] Y (km)	Source Elevation Feet Above MSL	Source Sound Level (dBA)	Source Sound Level Distance (ft)
1	Haul Trucks (6)	--	--	--	101	50
	Water Truck (1)	--	--	--	90	50
	FEL (1) --	--	--	84	50	2
	Easi-Miner (1)	--	--	--	90	50
	Diesel Pump (1)	--	--	--	66	50
	Sum	821.30	251.66	177	102	50
2	Haul Trucks (6)	--	--	--	101	50
	Water Truck (1)	--	--	--	90	50
	FEL (1) --	--	--	84	50	2
	Easi-Miner (1)	--	--	--	90	50
	Diesel Pump (1)	--	--	--	66	50
	Sum	821.89	252.07	358	102	50
3	Scrapers (2)	--	--	--	89	50
	Topsoil Dozer (2)	--	--	--	86	50
	Sum	822.60	252.43	397	91	50
4	Scrapers (2)	--	--	--	89	50
	Topsoil Dozer (2)	--	--	--	83	50
	Sum	821.04	252.98	423	90	50
5	OB Dozer (4)	--	--	--	89	50
	BWE (2) --	--	--	83	50	1
	Sum	821.25	252.47	358	90	50
6	OB Dozer (4)	--	--	--	89	50
	Dragline (2)	--	--	--	83	50
	Sum	820.95	252.22	267	90	50
7	Spoils Dozers (2)	820.69	251.27	477	86	50
8	Fuel Trucks (2)	--	--	--	93	50
	Water Trucks (2)	--	--	--	93	50
	Other Trucks (3)	--	--	--	95	50
	Sum	820.83	251.92	177	99	50
9	Other Trucks (3)	823.75	251.61	420	95	50
10	Truck Unloading	--	--	--	78	50
	Crushers (2)	--	--	--	76	50
	Other Trucks (2)	--	--	--	93	50
	Sum	820.95	252.53	177	93	50
11	Truck Unloading	--	--	--	78	50
	Crushers (2)	--	--	--	76	50
	Other Trucks (2)	--	--	--	93	50
	Sum	822.21	251.80	177	93	50
12	Conveyor Transfer	820.22	252.98	430	82	50
13	Conveyor Transfer	819.76	251.76	444	82	50
14	Conveyor Transfer	822.75	251.55	177	82	50
15	Conveyor Transfer	822.96	251.55	420	82	50
16	Conveyor Transfer	823.26	251.61	415	82	50
17	Grader (1)	--	--	--	90	50
	Other Trucks (3)	--	--	--	95	50
	Conveyor Transfer	--	--	--	82	50
	Sum	824.13	251.57	427	96	50
18	Grader (1)	--	--	--	90	50
	Other Trucks (3)	--	--	--	95	50
	Sum	820.52	250.94	461	96	50

Source: LCRA, 1984a

Table 3-32
CUMMINS CREEK PROJECT
NOISE SOURCE INVENTORY
OVERLAND CONVEYOR

Numeric Identification	Noise Sources Present	Source Location East X (km)	Source Location North Y (km)	Source Elevation Feet Above MSL	Source Sound Level (dBA)	Source Sound Level Distance (ft)
1	Enclosed Conveyor Transfer	824.09	246.03	500	63	50
2	Conveyor - Point 1	824.09	247.44	455	63	50
3	Conveyor - Point 2	824.12	248.81	430	63	50
4	Conveyor - Point 3	824.12	250.15	410	63	50
5	Conveyor Transfer	--	--	--	82	50
	Other Trucks (3)	--	--	--	95	50
	Grader (1)	--	--	--	90	50
	Sum	824.13	251.57	247	96	50
6	Conveyor Transfer	823.26	251.61	415	82	50

Source: LCRA, 1984a

towns, etc.) were identified (Figure 3-5). The noise inventory for mine year eight was used as the worst-case for potential noise levels because it is expected to have the highest concentration of equipment in operation near sensitive locations. Based on the use of conservative assumptions, the baseline monitoring data, and the worst-case noise inventories, the models' predictions would represent the highest calculated noise levels around the mine and conveyor.

The results of the modeling for mining noise levels have been mapped on Figures 3-6 and 3-7. Results of the modeling for the overland conveyor are drawn on Figure 3-8. To further qualify noise levels, calculations were included for the nearest highway location and the nearest residences. These are marked as *A, *B, and *C on Figure 3-6. At the nearest highway location (*A in Figure 3-6), the model calculated the mine noise level to be 56 dBA. Considering the existing baseline noise level of 67 dBA for highways, the mining noise would be obscured by the higher existing highway noise level.

At the nearest residences *B and *C in Figure 3-6, the mine noise levels were calculated in the model as 65 dBA and 54 dBA, respectively. The existing noise levels at these locations would be dominated by the the mining noise, increasing the levels to 65 dBA and 55 dBA at locations *B and *C, respectively. At Waldeck, the highest noise level was predicted to occur at night and was calculated to be 47 dBA, a 4dBA increase over the existing nighttime noise level. The modeling for the mine generally predicted that the highest off-property noise levels would occur in the area east of the active mining, particularly the support facilities and in the surge pile area. Noise levels resulting from operation of the overland conveyor system were calculated in the model to be lower than the mining noise levels. However, all points located 50 feet from the conveyor were predicted to have noise levels of 63 dBA under calm conditions. Since the conveyor was designed to operate 16 hours per day, no calculations for nighttime levels were produced.

Operational noise levels at the Fayette Power Plant resulting from the addition of Units 3 and 4 were calculated as follows:

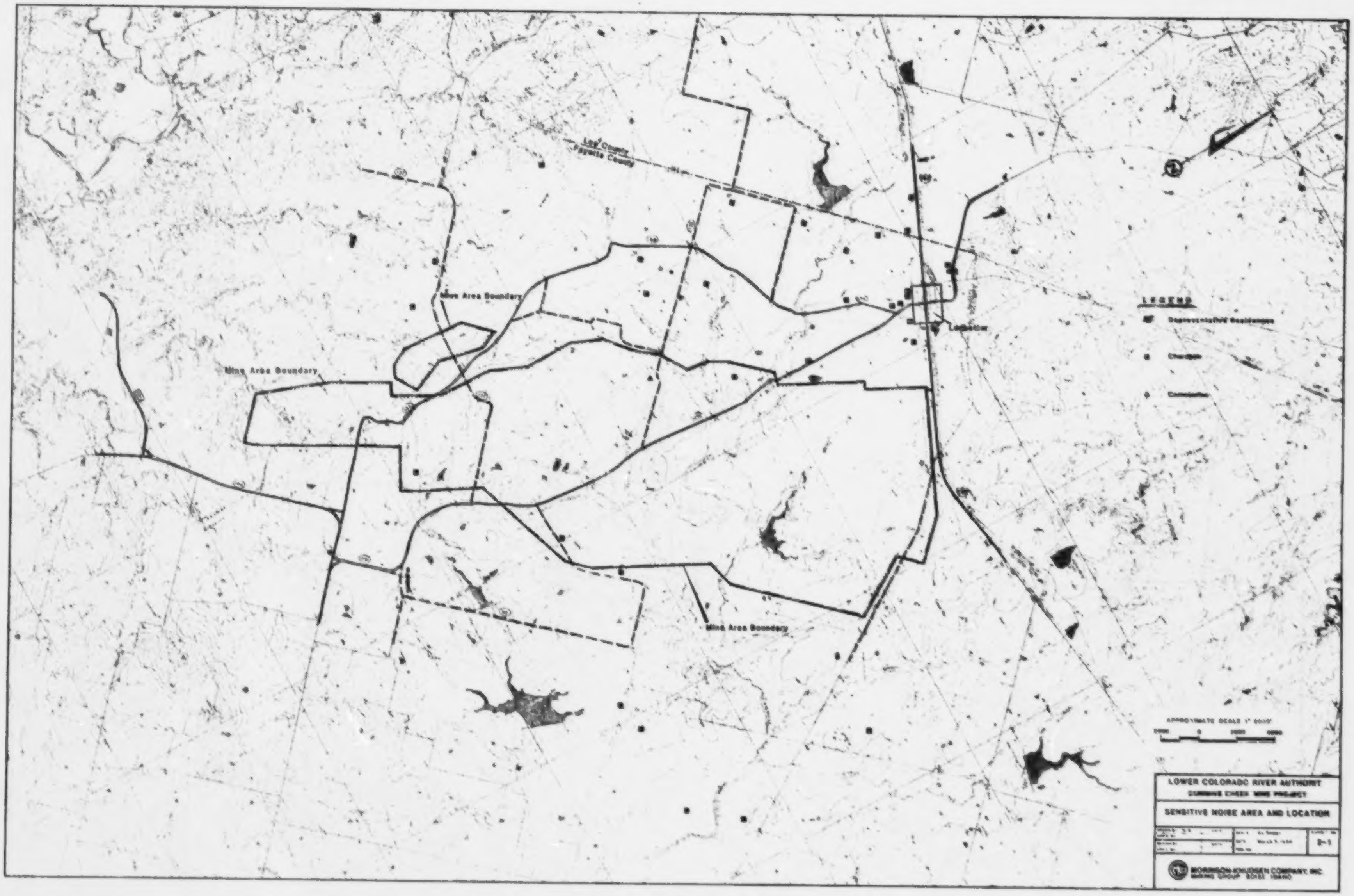
Location*	Noise level (Ldn)
1	73
2	64
3	61
4	59
5	68

*See Table 3-29 and Figure 3-4.

Impact Assessment

There are three different criteria by which the predicted noise levels are evaluated. These include EPA's guidelines (Table 3-33), the U.S. Department of Housing and Urban Development (HUD) standards (Table 3-34) and a selected study by Kryter (1970) on human reaction to noise (Figure 3-9).

Figure 3-5


Lee County
Fayette County
Mine Area Boundary
Mine Area Boundary
Mine Area Boundary
Ledbetter
LEGEND
Representative Residences
Churches
Cemeteries
APPROXIMATE SCALE 1" 2000'
2000 0 2000 4000
LOWER COLORADO RIVER AUTHORITY
CUMMINS CREEK MINE PROJECT
SENSITIVE NOISE AREA AND LOCATION
3-1
MORRISON-KNUDSEN COMPANY, INC.
MINING GROUP BOISE, IDAHO

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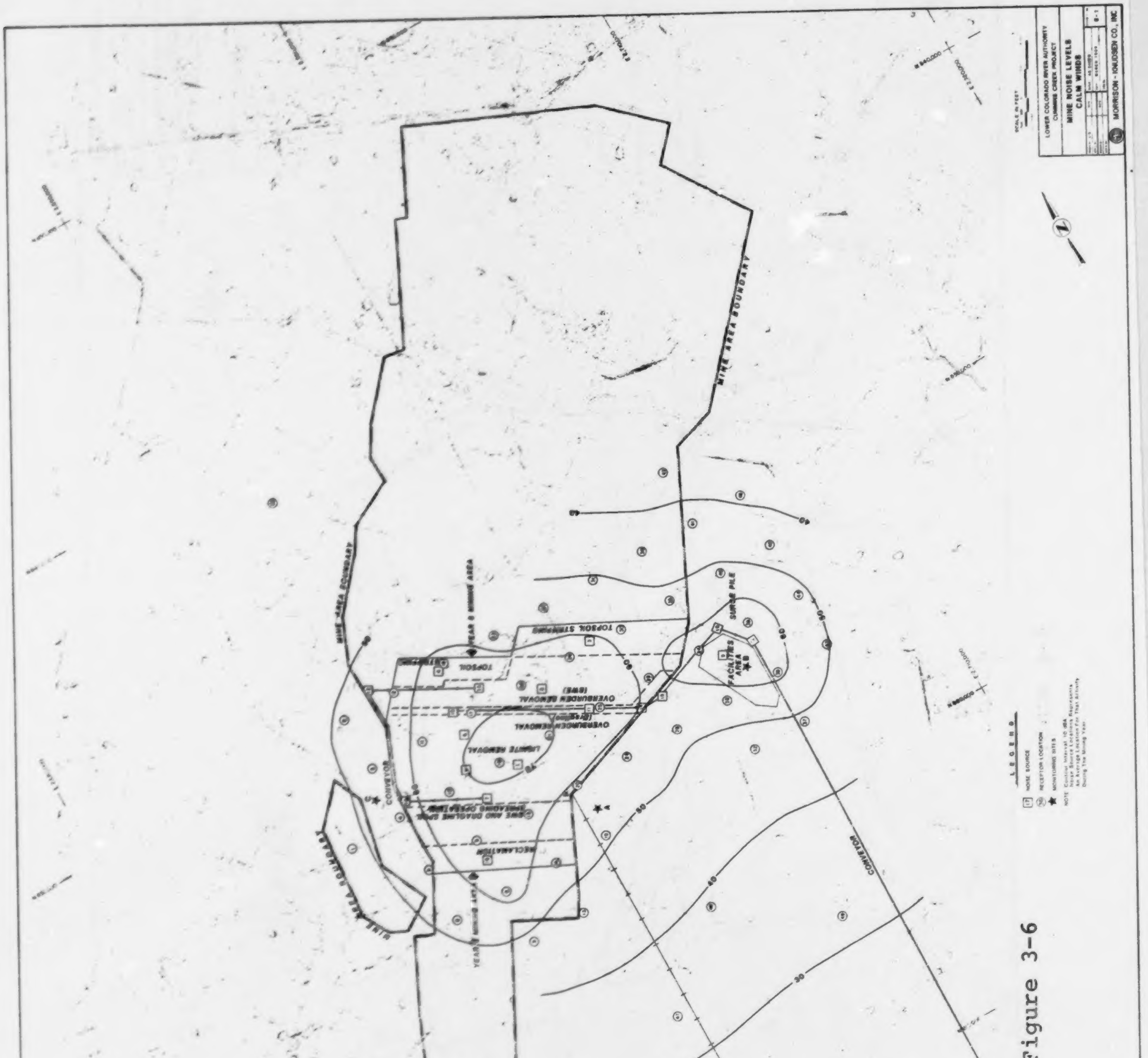

LOWER COLORADO RIVER AUTHORITY
CUMMINS CREEK PROJECT
MINE NOISE LEVELS
CALM WINDS
MORRISON - KNUDSEN CO., INC.
SCALE IN FEET
LEGEND
NOISE SOURCE
RECEPTOR LOCATION
MONITORING SITES
NOTE: Contour Interval 10 dBA
Noise Source Locations Represents An Average Location For That Activity During The Mining Year.
MINE AREA BOUNDARY
TOPSOIL STRIPPING
TOPSOIL
OVERBURDEN REMOVAL (BWE)
OVERBURDEN REMOVAL (Dragline)
LIGNITE REMOVAL
BWE AND DRAGLINE SPOIL SPREADING OPERATIONS
RECLAMATION
YEAR 5 MINING AREA
YEAR 8 MINING AREA
CONVEYOR
FACILITIES AREA
SURGE PILE
80
70
60
50
40
30

Figure 3-6

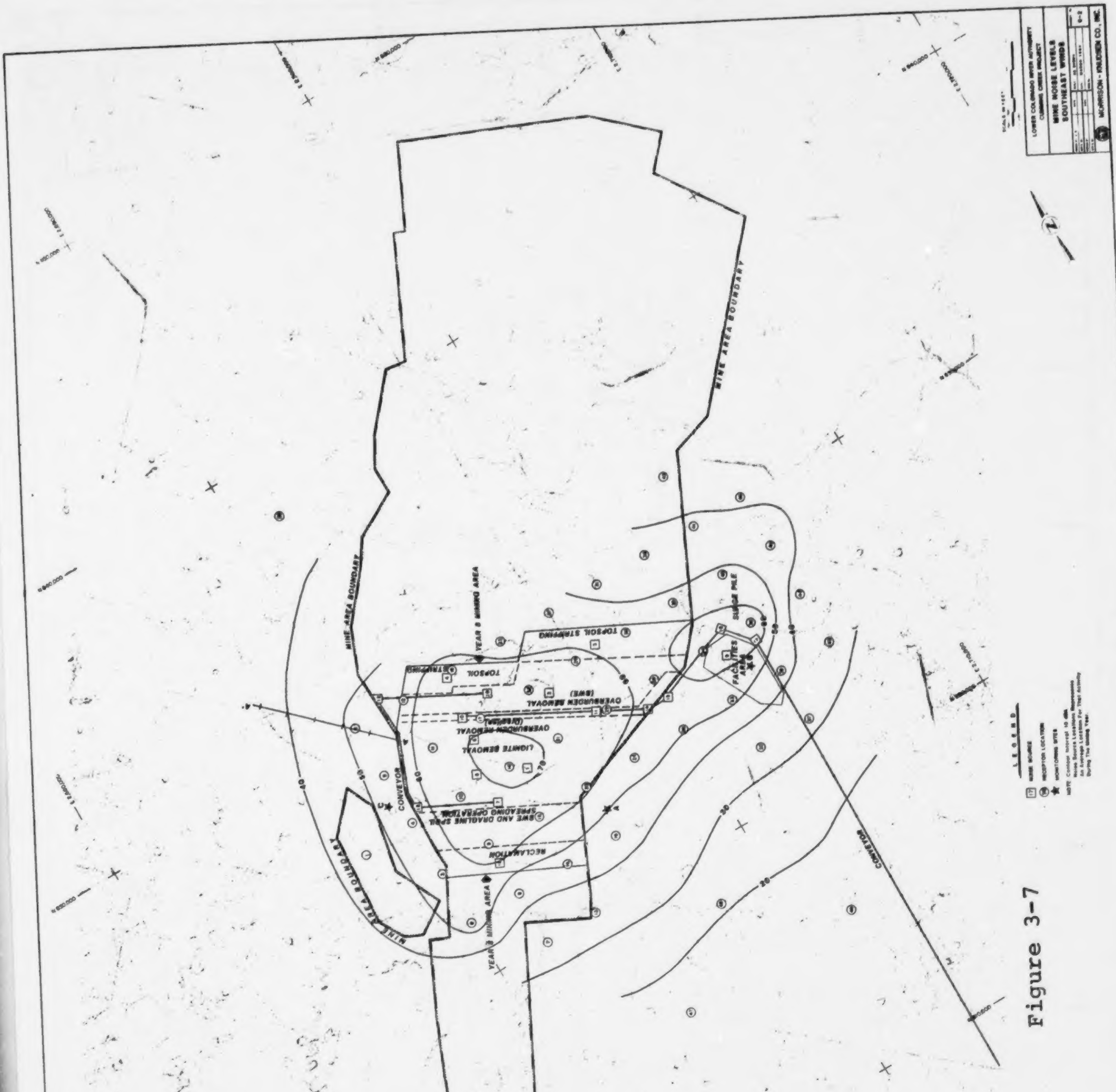

LOWER COLORADO RIVER AUTHORITY
CUMMINS CREEK PROJECT
MINE NOISE LEVELS
SOUTHEAST WINDS
MORRISON-KNUDSEN CO., INC.
LEGEND
NOISE SOURCE
RECEPTOR LOCATION
MONITORING SITES
NOTE: Contour Interval 10 dBA
Noise Source Locations Represent An Average Location For That Activity During The Mining Year.
MINE AREA BOUNDARY
TOPSOIL STRIPPING
OVERBURDEN REMOVAL (BWE)
OVERBURDEN REMOVAL (DRAGLINE)
LIGNITE REMOVAL
BWE AND DRAGLINE SPOIL SPREADING OPERATION
RECLAMATION
YEAR 8 MINING AREA
CONVEYOR
SURGE PILE
FACILITIES AREA
70
60
50
40
30
20
N

Figure 3-7

Figure 3-8

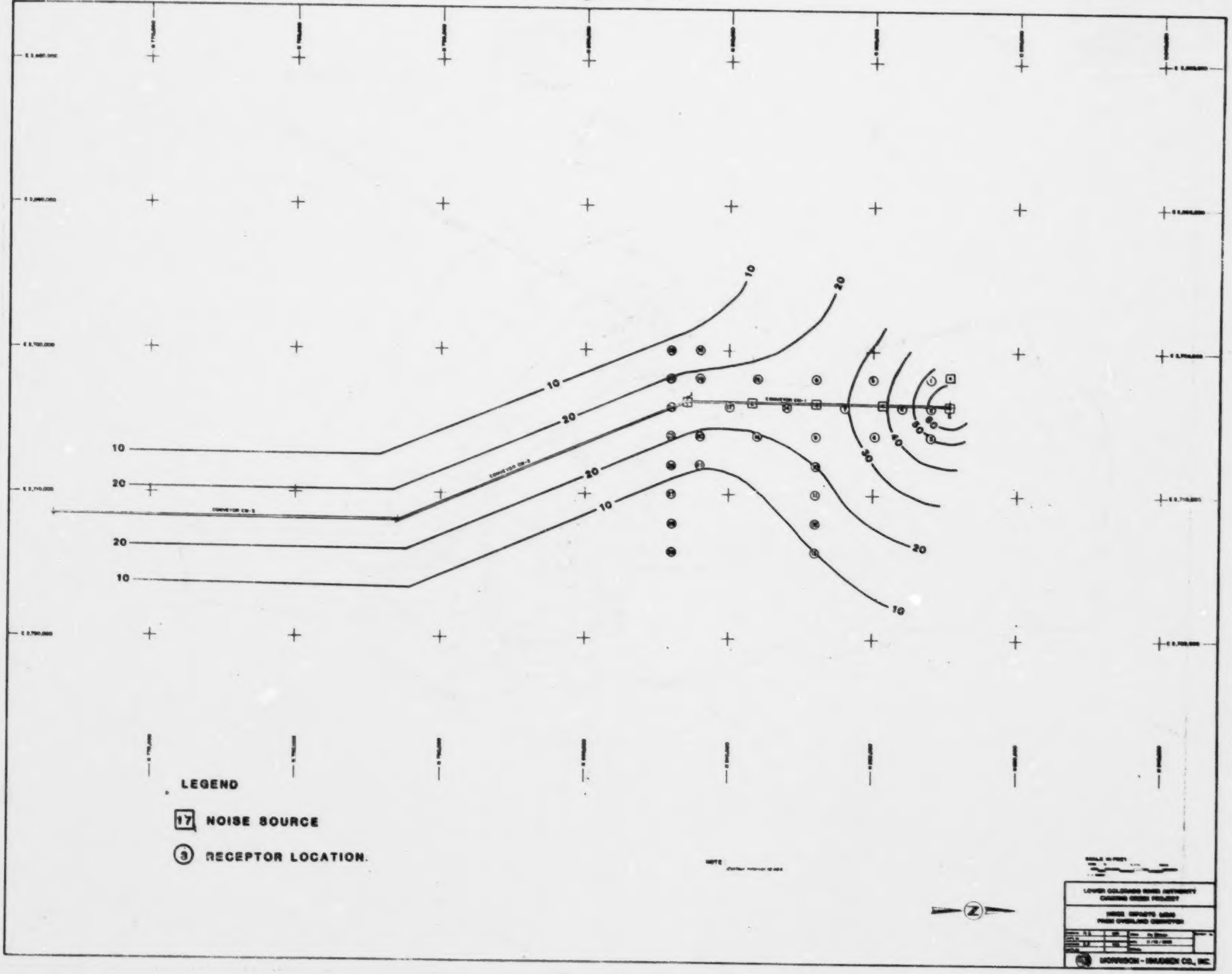

10
20
30
40
50
60
LEGEND
17 NOISE SOURCE
③ RECEPTOR LOCATION.
N
MORRISON - KNUDSEN CO., INC.

Table 3-33

YEARLY AVERAGE* EQUIVALENT SOUND LEVELS IDENTIFIED AS REQUISITE TO PROTECT THE PUBLIC HEALTH AND WELFARE WITH AN ADEQUATE MARGIN OF SAFETY

	Measure	Indoor			Outdoor		
		Activity Interference	Hearing Loss Consideration	To Protect Against Both Effects (b)	Activity Interference	Hearing Loss Consideration	To Protect Against Both Effects (b)
Residential with Outside Space and Farm Residences	L_{dn}	45		45	55		55
	$L_{eq(24)}$		70			70	
Residential with No Outside Space	L_{dn}	45		45			
	$L_{eq(24)}$		70				
Commercial	$L_{eq(24)}$	(a)	70	70(c)	(a)	70	70(c)
Inside Transportation	$L_{eq(24)}$	(a)	70	(a)			
Industrial	$L_{eq(24)}$(d)	(a)	70	70(c)	(a)	70	70(c)
Hospitals	L_{dn}	45		45	55		55
	$L_{eq(24)}$		70			70	
Educational	$L_{eq(24)}$	45		45	55		55
	$L_{eq(24)}$(d)		70			70	
Recreational Areas	$L_{eq(24)}$	(a)	70	70(c)	(a)	70	70(c)
Farm Land and General Unpopulated Land	$L_{eq(24)}$				(a)	70	70(c)

Code:

a. Since different types of activities appear to be associated with different levels, identification of a maximum level for activity interference may be difficult except in those circumstances where speech communication is a critical activity. (See Figure D-2 for noise levels as a function of distance which allow satisfactory communication.)

b. Based on lowest level.

c. Based only on hearing loss.

d. An $L_{eq(8)}$ of 75 dB may be identified in these situations so long as the exposure over the remaining 16 hours per day is low enough to result in a negligible contribution to the 24-hour average, i.e., no greater than an L_{eq} of 60 dB.

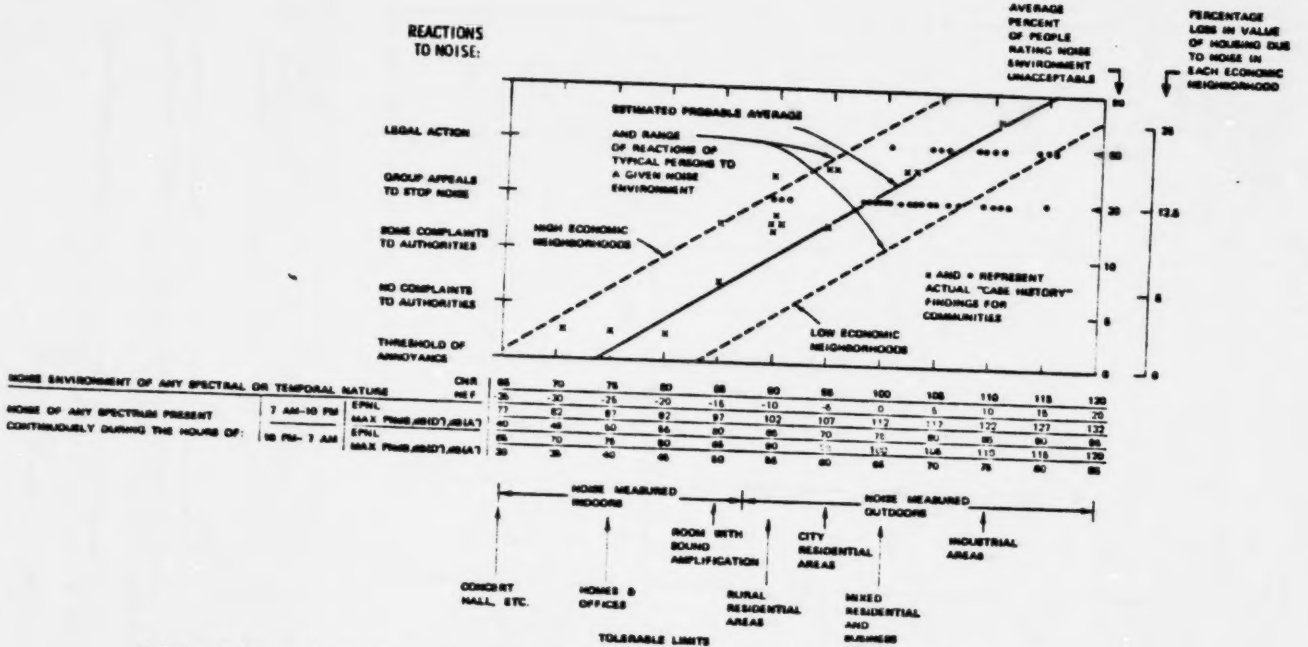
Note: Explanation of identified level for hearing loss: The exposure period which results in hearing loss at the identified level is a period of 40 years.

*Refers to energy rather than arithmetic averages.

Source: EPA, 1974

Figure 3-9

SELECTED STUDY - HUMAN REACTION TO NOISE*



Relation between a habitual composite noise rating and: (a) community reactions to noise (left-hand ordinate); (b) attitudes of individuals of the unacceptability of the noise (first ordinate on right); and (c) percentage loss in value of housing (second left-hand ordinate). Parameters are economic status of neighborhoods. The data on percentage loss in value of housing is based on a recent extensive, long range analysis of this problem in England (*Commission of London's Third Airport Papers and Proceedings* VII, Part II, and *Further Research Team Work* 51, Templar House, 79/81 High Holborn, London, WC 1, England). dB(D') minus 6 = dB(D); dB(A') minus 13 = dB(A). After Kryter (458).

*Source: Kryter, 1970

TABLE 3-34

U.S. DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT

SITE ACCEPTABILITY STANDARDS*

	Day-night average sound level (in decibels)
Acceptable	Not exceeding 65 dB
Normally unacceptable	Above 65 dB but not exceeding 75 dB
Unacceptable	Above 75 dB

*24 CFR 51.103 Criteria and Standards, Federal Register 40864, July 12, 1979, Rules and Regulations.

In comparison to EPA's measure of 55 (Ldn), it is evident that noise levels predicted by the model for the mine, power plant and overland conveyor exceed this criteria. In comparison to HUD's standards, two of the five locations near the power plant and one off-boundary mine receptor (i.e., *B in Figure 3-6) meet or exceed "normally unacceptable" levels of 65 (Ldn). The remainder of the predicted noise levels, for the mine, power plant and conveyor are below the 65 dB level, and therefore, within HUD's "acceptable" range. In comparison to the selected study conducted on human reactions to noise, the predicted levels are generally categorized as unacceptable to about 20% of the people affected and in a range that results in some complaints to authorities. In conclusion, noise from the mine, power plant and conveyor is expected to cause occasional, short-term, major or minor, adverse impacts on nearby receptors over the life of the project.

Distance from the source will reduce the noise level and therefore should lessen the adverse impact. This reduction can be improved by constructing barriers between the source and the receptor to obstruct or dissipate the noise. Vegetation provides little noise reduction unless there is sufficient density and depth to the plantings. However, walls and barriers can significantly reduce noise levels. This would include the walls of houses, earth berms or other solid objects that block the line of sight from the source to the receiver. Another effective method of reducing noise is lowering the elevation of the source. (Rau and Wooten, 1980; Canter, 1977; and EPA, 1971b).

Certain measures have been included in the project planning and design to reduce projected noise levels and resulting adverse impacts.

- ° The overland conveyor is to be partially covered. Vegetation would be planted or left in place to help absorb operational noise.
- ° LCRA's commitment to maintain equipment properly, keep noisy equipment within the mine pit or below surface elevation, and avoid sensitive receptor sites, to the extent possible.

3.5 HYDROLOGY

3.5.1 Surface Water

Existing Conditions

The project area is located in the central portion of the Colorado River Basin (Texas Water Quality Segment: 1402) which has generally good water quality (TDWR, 1982). This area's surface water, like much of the basin, is characterized by ephemeral and intermittently flowing streams. In addition to these, small stock ponds have been built in the area by local residents. The U.S. Department of Agriculture - Soil Conservation Service (SCS) has provided assistance under authority of the Watershed Protection and Flood Prevention Act (Public Law 83-566, as amended) to local sponsors for development and implementation of a flood prevention project, Cummins Creek Watershed. The local sponsors are the Lee-Fayette Counties Cummins Creek Water Control and Improvement District No. 1, the Burleson-Lee, Fayette, Colorado, and Austin Counties Soil and Water Conservation Districts, and the Lee County and the Fayette County Commissioners Courts. To date, 20 of the 31 planned floodwater retarding structures (Figure 3-10) have been installed, achieving 60 percent of the project's planned control with structures (Goerdel, 1984).

The mine permit area lies on the watershed divide of Rabbs and Cummins Creek. Jones Creek, and Blair Creek flow generally southwest to Rabbs Creek from the mining area. Turkey Creek, Pin Oak Creek and Shaw Creek flow generally northeast into Cummins Creek from the mining area. Both watersheds drain into the Colorado River.

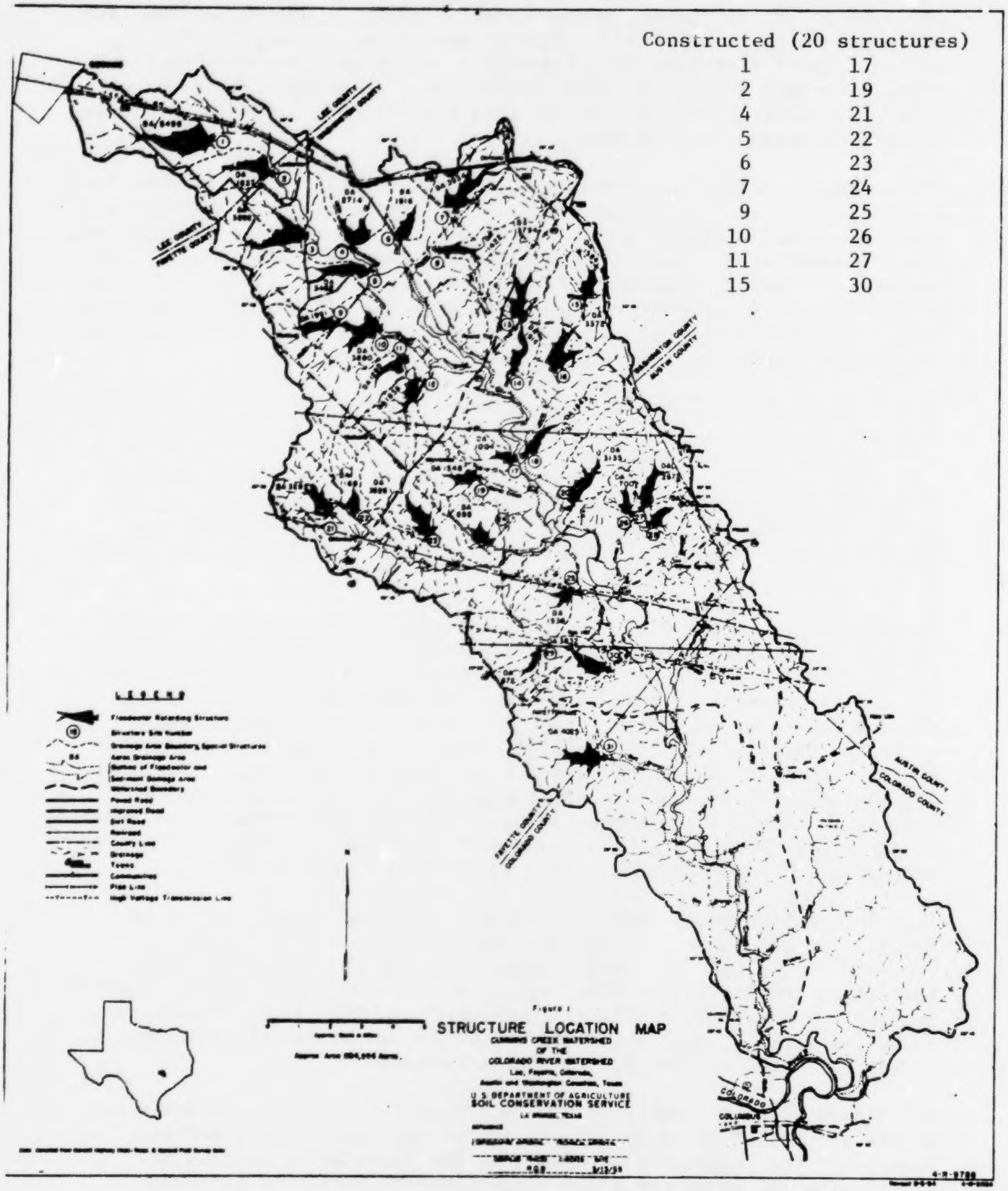
The proposed conveyor corridor begins at the mine permit area and extends south-southwest through the watershed of Clear Creek, a tributary of Cummins Creek, to the Fayette Power Plant.

The plant area is drained by tributaries of Cedar Creek and has a company owned cooling pond in the watershed headwaters. The Fayette County (Cedar Creek) Reservoir was constructed in 1978 by the Lower Colorado River Authority (LCRA) to supply cooling waters for two 600 megawatt coal fired steam generators (Units 1 and 2). The 2,400 acre cooling pond is located on Cedar Creek, an intermittent stream of the Colorado River watershed that now receives an average daily discharge of 0.5 cfs from the reservoir to comply with a water use permit. The earth-filled dam impounds 72,000 acre-feet of water with a maximum depth of 70 feet and an average depth of 30 feet. Supplemental water is pumped four miles from the Colorado River to maintain a constant water level of 390 feet above mean sea level.

Public access to the reservoir is controlled by LCRA through two parks. The park provides areas for bank fishing, overnight camping, parking and boat launching.

Stocking of game species previous to impoundment was done as part of the fisheries management program. A recent survey by the Texas Parks and Wildlife Department, that manages the fisheries resource, found the reservoir waters to be clear and alkaline with high total hardness

Figure 3-10


LEE COUNTY
FAYETTE COUNTY
WASHINGTON COUNTY
AUSTIN COUNTY
COLORADO COUNTY
COLORADO
COLUMBUS
LEGEND
Floodwater Retarding Structure
Structure Site Number
Drainage Area Boundary, Special Structures
Acres Drainage Area
Outline of Floodwater and
Sediment Storage Area
Watershed Boundary
Paved Road
Improved Road
Dirt Road
Railroad
County Line
Drainage
Towns
Communities
Pipe Line
High Voltage Transmission Line
Approx. Area 204,000 Acres.
Figure 1
STRUCTURE LOCATION MAP
CUMMINS CREEK WATERSHED
OF THE
COLORADO RIVER WATERSHED
Lee, Fayette, Colorado,
Austin and Washington Counties, Texas
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
LA GRANGE, TEXAS
4-R-9788

Constructed (20 structures)

1
2
4
5
6
7
9
10
11
15
17
19
21
22
23
24
25
26
27
30

Reproduced from best available copy.

(Table 3-35). Water quality is not considered to be limiting to the fish community (Bounds, 1984). Surface temperature was high in the area of the power plant discharge and stratification was pronounced due to layering of less dense, warmer waters. About 35 percent of the lake was observed to be occupied by aquatic vegetation, mainly Florida elodea. Sport fish habitat was adequate including submerged brush and timber, as well as shallow water vegetation (See Biological Resources Section). Cedar Creek also drains into the Colorado River about midway between La Grange and Columbus.

Stream flows in the Colorado River upstream from the mouth of Rabbs Creek are controlled by LCRA's operation of the Highland Lakes. The Highland Lakes are located approximately 130 miles upstream from the Project Area. The Highland Lakes consist of a series of 6 dams and reservoirs in Llano, Burnet, and Travis Counties. The flow in the Colorado River at Columbus is approximately 1,080 cfs or greater 50 percent of the time. The river flow equals or exceeds 110 cfs at Columbus about 99 percent of the time. The 2 year, 7-day low flow is 266 cfs.

Data from actual flow measurements taken since 1979 from the mine area stations 6, 7, 8, and 9 (Figure 3-11) indicate that the area creeks are intermittent with non-flowing conditions for extended periods of time (LCRA, 1984a). Significant statistics can not yet be drawn from this data because of the short period of record and lack of data continuity. However, a long-term continuous water level monitoring station with a verified stage-discharge rating curve is being developed on Cummins Creek by LCRA.

The hydrologic response of the local drainage basins has been characterized by using long-term stream flow records from the U.S. Geological Survey (USGS) Gage 08160800 on Redgate Creek. This creek, a tributary of Cummins Creek downstream of the Project Area, has a drainage area of 17.3 square miles, which is equivalent in size to Cummins Creek watershed upstream of the Mine Study Area. Flow records indicate that Redgate Creek at the gaging point is an intermittent stream. Land use, vegetation patterns, and overall topography in the area also appear similar to those in the upper Cummins Creek drainage. Monthly discharges, in acre-feet, recorded at this gage were converted to mean, minimum, and maximum monthly runoff volumes per square mile (Table 3-36).

This information would lead us to expect an annual runoff volume of 245.8 ac-ft per square mile of drainage area for creeks within the vicinity of the Cummins Creek Project Area. A flow duration table, indicating the portion of time that a certain streamflow may be expected to equal or exceed that flow, is presented as Table 3-37. The 2-year, 7-day low flow estimate is commonly used for water quality assessments. It was estimated as zero for the local streams.

All claims of water rights within the Project Area or its vicinity are in the process of adjudication as part of the Lower Colorado River Segment of the Colorado River Basin by the Texas Water Commission (TWC). The TWC completed a preliminary determination of all water rights claims in the Lower Colorado River Segment (August 31, 1982).

TABLE 3-35

Water Quality Data From a Mid-Lake Station
on Cedar Creek Reservoir,
May, July, August, and September, 1983.

Station Depth (m)	Temp. (C)	D.O. (ppm)	pH	Total Alk (ppm)	Specific Conductance (umhos/cm)	Turbidity (JTU)	Total Hardness (ppm)
May							
Surface	30.0	8.7	8.4	140		0	210
Mid-depth (9 M)	23.7	5.2	7.6	140		30	210
Bottom (18 m)	18.0	1.9	7.3	140		30	210
July							
Surface	33.0	7.8	8.9	110		5	150
Mid-depth (7 m)	28.5	4.0	8.9	110		10	150
Bottom (17 m)	17.9	0.0	7.3	160		5	180
August							
Surface	35.0	7.4					
Mid-depth (10 m)	24.5	0.2					
Bottom (20 m)	18.0	0.2					
September							
Surface	25.5	8.8	8.3	110		0	160
Mid-depth (10 m)	25.0	4.2	8.3	110		10	
Bottom (20 m)	18.0	0.3	7.6	150		12	

Figure 3-11

CUMMINS CREEK PROJECT
SURFACE WATER MONITORING STATIONS

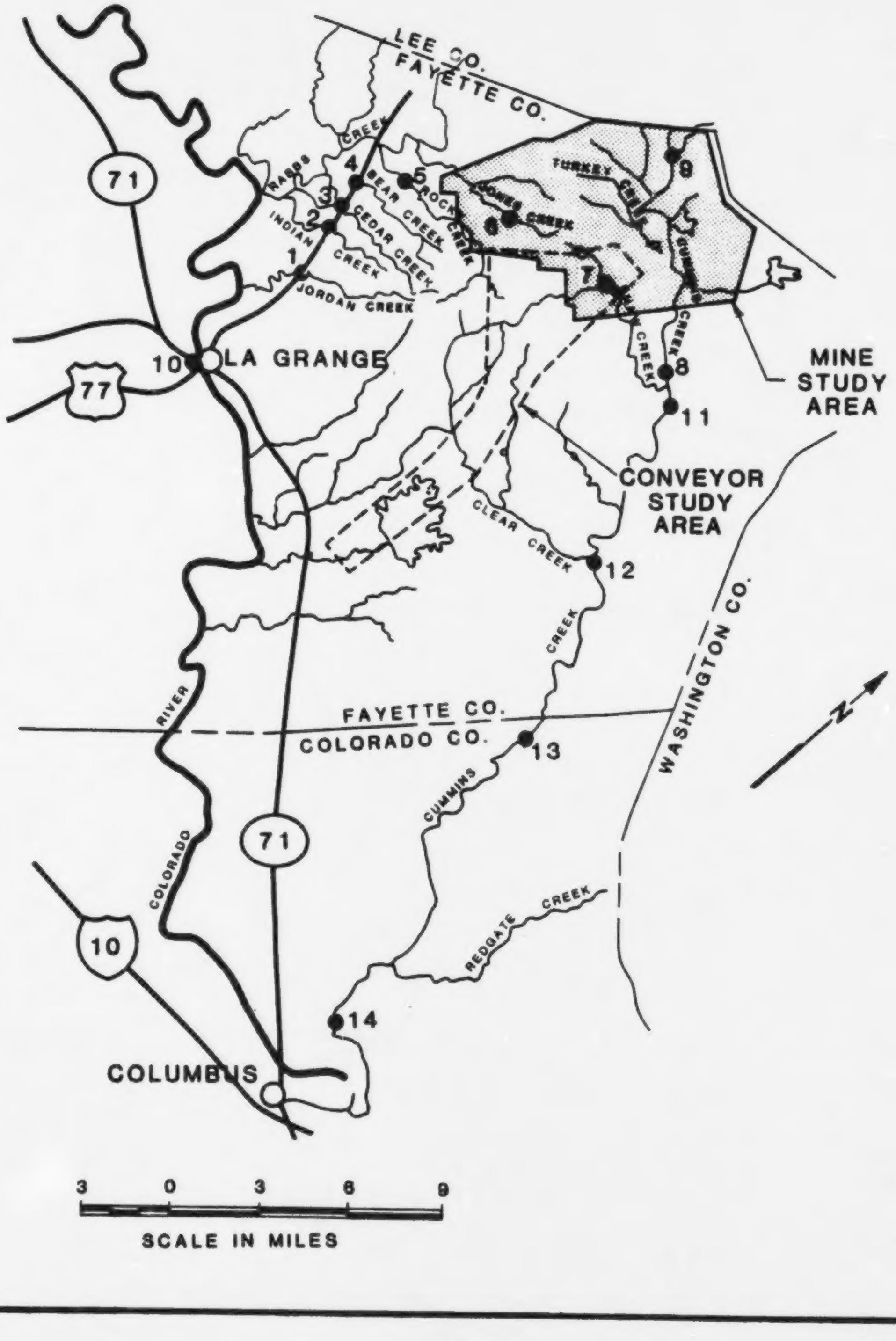

LEE CO.
FAYETTE CO.
TURKEY CREEK
JONES CREEK
RABBS CREEK
INDIAN CREEK
BEAR CREEK
ROCK CREEK
CEDAR CREEK
JORDAN CREEK
CREEK
CREEK
1
2
3
4
5
6
7
8
9
10
11
12
13
14
LA GRANGE
71
77
MINE STUDY AREA
CONVEYOR STUDY AREA
CLEAR CREEK
CREEK
WASHINGTON CO.
N
FAYETTE CO.
COLORADO CO.
CUMMINS
RIVER
COLORADO
71
REDGATE CREEK
10
COLUMBUS
3
0
3
6
9
SCALE IN MILES

TABLE 3-36

CUMMINS CREEK MINE
EXPECTED RUNOFF PER SQUARE MILE OF DRAINAGE AREA*

Month	Minimum Runoff Per Square Mile (Acre-Feet)	Maximum Runoff Per Square Mile (Acre-Feet)	Mean Runoff Per Square Mile (Acre-Feet)	Distribution of Mean Runoff (%)
January	0.87	113.3	21.7	8.8
February	0.69	98.8	24.0	9.8
March	0.69	135.3	23.3	9.5
April	0.81	124.7	29.0	11.8
May	1.16	173.4	49.2	20.0
June	0.29	166.5	25.6	10.4
July	0.03	13.2	2.8	1.1
August	0.00	61.8	5.0	2.0
September	0.14	132.4	14.7	6.0
October	0.00	174.0	24.5	9.9
November	0.24	47.5	8.4	3.4
December	0.87	86.1	17.6	7.2
Annual	31.45	626.8	245.8	100.0

---

* Based on USGS Gage 08160800 on Redgate Creek near Columbus, Texas. Data collected from May 1962 through September 1977.

TABLE 3-37

CUMMINS CREEK MINE
EXPECTED FLOW DURATION TABLE FOR ONE-SQUARE-MILE DRAINAGE AREAS WITHIN THE MINE AREA*

Discharge Per Square Mile (CFS)	Average Time Discharge is Equalled or Exceeded (%)
0.0	100.0
0.1	24.0
0.2	13.8
0.3	9.6
0.4	8.0
0.5	6.9
0.6	6.2
0.7	5.7
0.8	5.2
0.9	4.9
1.0	4.5
1.2	4.1
1.4	3.7
1.8	3.1
2.0	2.9
2.5	2.5
3.0	2.1
4.0	1.6
5.0	1.3
10.0	0.8
20.0	0.3
30.0	0.1
40.0	0.1
50.0	0.0

* Based on USGS Gage 08160800 on Redgate Creek near Columbus, Texas.

Between the Rabbs Creek confluence and the Cummins Creek confluence with the Colorado River, there existed 42 claims under Section 11.303 and two permits have been issued. Two claims were recognized by the TWC in their preliminary determination, as well as the permits, with a total diversion of 76,362 ac-ft/yr and off channel storage of 11,824 ac-ft.

Downstream of the Cummins Creek confluence with the Colorado River, there are 26 Section 11.303 claims, 16 certified filings and 7 permits have been issued. These claims total 1,423,821 ac-ft/yr in diversions and 202,600 ac-ft impounded.

Claims in the Cummins Creek watershed total 144 ac-ft with rights recognized to increase the total to 164 ac-ft. Claims in the Rabbs Creek watershed total 95.5 with rights recognized to increase the total to 134 ac-ft.

Water quality data on the Colorado River have been reported by the USGS since 1967. LCRA also monitors a station (10) on the Colorado River at La Grange below the confluence with Rabbs Creek. These data were supplemented by monthly water quality constituent concentrations determined by analysis of grab samples from 12 stations along Cummins Creek, its tributaries, or those of Rabbs Creek since 1979 (See Figure 3-11). The water quality of the Colorado River is generally good between the Smithville and Columbus Station. These two locations are upstream and downstream of the Rabbs and Cummins Creek confluences, respectively. For the period of record, very few exceedences of water quality standards for the Colorado River (Segment 1402) have been recorded (Tables 3-38 and 3-39).

Sulfate concentrations exceeded standards in a few samples and high numbers of fecal coliforms have been determined on several occasions. Reported levels of dissolved oxygen, pH and temperature were consistently good.

The LCRA Station #10 on the Colorado River at La Grange (Table 3-40) showed values above its segment standards for chloride, total dissolved solids and fecal coliforms. It also had some total suspended solids concentrations above the standards for acid mine drainage indicating high background levels.

LCRA stations 8, 9, 11, 12, 13 and 14 monitored Cummins Creek. Data were sufficient for summarization only at stations 8 and 9 (Tables 3-41 and 3-42) downstream and upstream of the mine area, respectively. Values for water constitients at the other stations fell in similar ranges. Station 7 monitors Shaw Creek upstream of its confluence with Cummins Creek below the proposed mine facilities (Table 3-43). Station 6 monitors Jones Creek in the Rabbs Creek watershed in the southwest portion of the mine area (Table 3-44). These creeks would be affected by the project.

TABLE 3-38

CUMMINS CREEK PROJECT
SURFACE WATER QUALITY IN THE PERMIT AREA
COLORADO RIVER AT SMITHVILLE BASTROP CO.

Constituent*	No. of Samples	Minimum	Maximum	Average
Dissolved Oxygen	11	7.4	10.4	8.4
pH, std. units lab	11	7.5	8.0	7.65
Conductivity umhos/cm	11	435.0	626.0	538.0
Alkalinity (as $CaCO_3$)	11	107.0	195.0	164.0
Hardness (as $CaCO_3$)	11	150.0	240.0	205.0
Total Suspended Solids	--	-----	-----	-----
Total Dissolved Solids	11	242.0	346.0	296.0
Biochemical Oxygen Demand	11	0.1	2.2	0.9
Ammonia Nitrogen	11	0.01	0.34	0.09
Organic Nitrogen	11	0.18	3.8	0.8
Total Phosphorus	11	0.09	0.49	0.19
Sulfate	11	1.0	49.0	38.0
Chloride	11	38.0	56.0	47.0
Flouride (Diss.)	6	0.0	0.3	0.23
Silica	11	8.4	12.0	9.7
Fecal Coliform, No./100 ml	--	---	----	----
Aluminum	--	---	----	----
Arsenic	1	---	----	.01
Beryllium	--	---	----	----
Cadmium	--	---	----	----
Calcium	11	40.0	68.0	51.4
Chromium	--	---	----	----
Copper	--	---	----	----
Iron, Total	1	---	----	.370
Iron, Dissolved	--	---	----	----
Magnesium	10	22.0	25.0	23.0
Manganese, Total	1	---	----	.03
Manganese, Dissolved	--	---	----	----
Mercury	1	---	----	.0008
Molybdenum	--	---	----	----
Nickel	1	---	----	.02
Potassium, Dissolved	10		4.40	3.65
Selenium	1	---	----	.002
Sodium	--	---	----	----
Strontium	--	---	----	----
Zinc	1	---	----	.03

* Concentration in mg/l unless otherwise noted.
"-" means less than
USGS station 0859500 and 21XWQB station 14020500 STORET data

TABLE 3-39

CUMMINS CREEK PROJECT
SURFACE WATER QUALITY IN THE PERMIT AREA
COLORADO RIVER AT COLUMBUS USGS 08161000[1]

Constituent*	No. of Samples	Minimum	Maximum	Average [1]
Dissolved Oxygen	85	6.79	92.0	9.83
pH, std. units lab	118	6.4	8.8	7.69
Conductivity umhos/cm	118	240.0	757.0	538.53
Alkalinity (as $CaCO_3$)	102	71.0	233.0	160.18
Hardness (as $CaCO_3$)	101	92.0	280.0	201.22
Total Suspended Solids	4	143.0	367.0	277.0
Total Dissolved Solids	90	139.0	424.0	299.17
Biochemical Oxygen Demand	86	0.1	8.2	1.79
Ammonia Nitrogen	9	0.0	0.08	0.02
Organic Nitrogen	51	0.0	2.09	0.54
Total Phosphorus	72	0.03	0.86	0.22
Sulfate	95	11.0	83.0	38.97
Chloride	102	5.8	68.0	47.70
Flouride	91	0.0	0.6	0.26
Silica	95	0.0	33.0	8.41
Fecal Coliform, No./100 ml	1	---	----	33.0
Aluminum	--	---	----	----
Arsenic	1	---	----	.002
Beryllium	--	---	----	----
Cadmium	1	---	----	1.0
Calcium	95	25.0	81.0	53.30
Chromium	1	---	----	.010
Copper	1	---	----	.002
Iron, Total	1	---	----	1.1
Iron, Dissolved	--	---	----	----
Magnesium	--	---	----	----
Manganese, Total	1	---	----	.05
Manganese, Dissolved	--	---	----	----
Mercury	1	---	----	.0008
Molybdenum	--	---	----	----
Nickel	--	---	----	----
Potassium	49	2.9	6.0	3.86
Selenium	1	---	----	.001
Sodium	52	10.0	50.0	30.19
Strontium	--	---	----	----
Zinc	1	---	----	.02
Uranium, dissolved	40	-0005	-0017	.0010

---

* Concentration in mg/l unless otherwise noted.
"-" means less than
1 STORET Data
1 Numerical average or single value

TABLE 3-40

CREEK PROJECT
QUALITY IN THE PERMIT AREA
NEAR LA GRANGE STATION 10 (Nov. 1979 - Nov. 1982)

Constituent*	No. of Samples	Minimum	Maximum	Average [1]
Dissolved Oxygen	17	6.4	14.2	9.2
pH, std. units lab 25°C	17	6.1	8.5	7.3
Conductivity umhos/cm lab	17	130.0	980.0	494.0
Alkalinity (as $CaCO_3$)	18	24.0	230.0	124.4
Hardness (as $CaCO_3$)	18	20.0	260.0	145.9
Total Suspended Solids	18	2.0	152.0	47.7
Total Dissolved Solids	18	113.0	692.0	313.0
Biochemical Oxygen Demand	18	1.0	6.0	2.35
Ammonia Nitrogen	18	-0.01	1.17	0.36
Organic Nitrogen	18	-0.01	2.38	0.68
Total Phosphorus	17	.03	1.00	0.30
Sulfate	18	-1	171.0	12.7
Chloride	18	2.0	480.0	70.5
Flouride	5	0.12	0.75	0.41
Silica	5	4.7	19.2	10.88
Fecal Coliform, No./100 ml	15	-100	16,800.0	2843.2
Aluminum	5	0.06	2.07	0.73
Arsenic	7	-0.001	-0.005	-
Berylium	5	-0.01	-0.01	-0.01
Cadmium	5	-0.001	0.005	-
Calcium	5	10.0	62.7	47.6
Chromium	5	-0.001	-0.10	-
Copper	5	-0.001	.005	-
Iron, Total	13	0.04	1.90	0.78
Iron, Dissolved	13	-0.01	0.30	0.13
Magnesium	5	1.14	18.8	8.03
Manganese, Total	13	-0.1	0.081	-039
Manganese, Dissolved	13	-0.001	0.09	-
Mercury	5	-0.0001	0.45	-
Molybdenum	5	-0.01	-0.01	-0.01
Nickel	5	0.05	-0.01	-
Potassium	5	4.25	8.91	6.01
Selenium	5	-0.001	-0.005	-
Sodium	5	19.0	36.4	31.4
Strontium	5	-0.05	0.65	0.422
Zinc	5	-0.05	0.02	0.02

---

* Concentration in mg/l unless otherwise noted.
"-" means less than.
[1] Numerical average or indicator if values less than detection were reported.

TABLE 3-41

CUMMINS CREEK PROJECT
SURFACE WATER QUALITY IN THE PERMIT AREA
CUMMINS CREEK STATION # 8 (1979-1983)

Constituent*	No. of Samples	Minimum	Maximum	Average[1]
Dissolved Oxygen	23	3.1	10.1	7.5
pH, std. units lab	24	5.0	7.8	6.6
Conductivity umhos/cm	23	40.0	1257.0	398.8
Alkalinity (as $CACO_3$)	32	16	180	78.8
Hardness (as $CACO_3$)	26	4	276	118.6
Total Suspended Solids	32	1	476	76.3
Total Dissolved Solids	32	0.5	917	242.7
Biochemical Oxygen Demand	30	-1	5	2.56
Ammonia Nitrogen	32	-.01	2.06	.37
Organic Nitrogen	30	-.01	1.59	.72
Total Phosphorus	32	-.01	.48	.12
Sulfate	32	-1	5	2.56
Chloride	32	4	120	52.7
Flouride	6	.11	.25	.17
Silica	6	-10	0.58	.19
Fecal Coliform, No./100 mg	19	-10	260	11.7
Aluminum	6	0.11	0.58	.19
Arsenic	6	-0.001	-0.10	-
Berylium	6	-0.01	-0.01	-0.01
Cadmium	6	-0.001	-0.10	-
Calcium	6	11.1	117	54.0
Chromium	6	-0.001	0.06	-
Copper	6	-0.001	0.004	-
Iron, Total	11	.12	1.36	.57
Iron, Dissolved	13	-0.10	.48	.01
Magnesium	6	1.9	5.85	4.18
Manganese, Total	11	-0.10	0.177	.09
Manganese, Dissolved	13	0.007	0.128	-
Mercury	8	-0.0001	0.01	-
Molybdenum	6	-0.01	-0.1	-
Nickel	6	0.01	-0.09	-
Potassium	6	3.2	79.1	17.3
Selenium	6	-0.001	-0.01	-
Sodium	6	11.4	82.3	42.3
Strontium	6	0.05	0.31	.14
Zinc	6	.005	0.042	.016

---

*Concentration in mg/l unless otherwise noted.

"1" means less than

[1] Numerical avarage or indicator if values below selection limits were reported.

TABLE 3-42

CUMMINS CREEK PROJECT
SURFACE WATER QUALITY IN THE PERMIT AREA
CUMMINS CREEK STATION 9 (1979-1983)

Constituent*	No. of Samples	Minimum	Maximum	Average[1]
Dissolved Oxygen	18	3.4	11.2	8.26
pH, std. units (lab)	20	5.0	7.5	6.53
Conductivity umhos/cm (lab)	10	30.0	249.0	105.5
Alkalinity (as $CaCO_3$)	27	6.0	48.0	30.4
Hardness (as $CaCO_3$)	22	4.0	192.0	44.4
Total Suspended Solids	27	1.0	492.0	44.4
Total Dissolved Solids	27	2.0	843.0	137.9
Biochemical Oxygen Demand	27	-1.0	6.0	2.6
Ammonia Nitrogen	27	-0.01	5.9	0.56
Organic Nitrogen	25	0.04	2.54	0.83
Total Phosphorus	27	-0.01	0.77	0.21
Sulfate	27	1.0	225.0	36.1
Chloride	27	2.0	14.0	8.57
Flouride	9	- 0.1	0.66	0.19
Silica	9	1.0	12.0	6.0
Fecal Coliform, No./100 ml	23	1.0	42800.0	2255.0
Aluminum	9	-0.1	149.0	21.5
Arsenic	9	-0.001	-0.10	-
Berylium	9	-0.01	-0.01	-0.01
Cadmium	9	-0.001	0.004	8.63
Calcium	9	4.3	13.6	8.63
Chromium	9	-0.001	-0.1	-
Copper	9	-0.001	0.004	-
Iron, Total	22	0.69	56.0	4.76
Iron, Dissolved	22	00.10	3.11	0.85
Magnesium	9	1.03	2.95	1.96
Manganese, Total	22	-0.1	0.173	0.14
Manganese, Dissolved	22	-0.1	0.364	0.07
Mercury	9	-0.0001	-0.025	-
Molybdenum	9	-0.01	-0.01	-
Nickel	9	0.01	-0.08	-
Potassium	9	1.8	17.4	5.85
Selenium	9	-0.001	-0.01	-
Sodium	9	4.22	21.4	10.1
Strotium	9	0.01	0.03	.08
Zinc	9	0.007	0.127	.9

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*Concentration in mg/l unless otherwise noted

"-" means less than

[1] Numerical average or indicator if values below detection limit were reported.

TABLE 3-43

CUMMINS CREEK PROJECT
SURFACE WATER QUALITY IN THE PERMIT AREA
CUMMINS CREEK STATION #7

Constituent*	No. of Samples	Minimum	Maximum	Average[1]
Dissolved Oxygen	12	2.6	11.8	8.50
pH, std. units (lab)	12	5.8	6.7	6.4
Conductivity umhos/cm (lab)	12	22	1000	214
Alkalinity (as $CaCO_3$)	12	8	46	27
Hardness (as $CaCo_3$)	12	8	72	34
Total Suspended Solids	12	11	647	79
Total Dissolved Solids	12	32	195	126
Biochemical Oxygen Demand	12	1	5	3
Ammonia Nitrogen	12	-0.01	2.3	0.65
Organic Nitrogen	12	0.12	17	0.89
Total Phosphorus	12	0.04	0.45	0.23
Sulfate	12	5	150	29
Chloride	11	2	14	7
Flouride	3	-0.10	0.64	0.34
Silica	3	4.47	13.2	8.69
Fecal Coliform, No./100 ml	11	0	2820	443
Aluminum	3	8.66	55.6	24.42
Arsenic	3	-0.001	-0.001	-0.001
Berylium	3	-0.01	-0.01	-0.01
Cadmium	3	-0.001	-0.006	0.003
Calcium	3	6.38	12.3	9.09
Chromium	3	0.001	0.001	0.001
Copper	3	0.003	0.007	0.005
Iron, Total	7	1.13	21.7	5.44
Iron, Dissolved	7	0.04	3.19	1.31
Magnesium	3	1.44	2.26	1.72
Manganese, Total	7	0.055	0.997	0.255
Manganese, Dissolved	7	0.010	0.789	0.50
Mercury	3	-0.001	-0.0001	-0.0001
Molybdenum	3	-0.01	-0.01	-0.01
Nickel	3	-0.001	-0.01	-0.007
Potassium	3	6.04	55.2	22.73
Selenium	3	-0.001	-0.01	-0.004
Sodium	3	3.98	37.7	22.26
Strotium	3	0.05	0.10	0.08
Zinc	3	0.017	0.120	0.058

TABLE 3-44

CUMMINS CREEK PROJECT
SURFACE WATER QUALITY IN THE PERMIT AREA
JONES CREEK STATION #6

Constituent*	No. of Samples	Minimum	Maximum	Average [1]
Dissolved Oxygen	5	4.0	11.2	8.6
pH, std. units	5	5.8	7.0	6.3
Conductivity umhos/cm	5	87	670	415
Alkalinity (as $CaCO_3$)	5	6	20	10
Hardness (as $CaCO_3$)	5	8	124	69
Total Suspended Solids	5	8	794	258
Total Dissolved Solids	5	255	424	340
Biochemical Oxygen Demand	5	-1	4	3.2
Ammonia Nitrogen	5	-0.01	1.02	0.67
Organic Nitrogen	5	0.07	0.34	0.26
Total Phosphorus	5	0.01	0.16	0.06
Sulfate	5	40	145	89
Chloride	5	12	150	93
Flouride	3	-0.10	0.65	0.91
Silica	3	14	38.8	26.3
Fecal Coliform, No./100 ml	5	30	3410	1038
Aluminum	3	9.18	76.0	33.8
Arsenic	3	-0.001	-0.001	.0.001
Beryllium	3	-0.01	-0.01	.0.01
Cadmium	3	-0.001	0.007	0.003
Calcium	3	11.8	27.7	18.2
Chromium	3	-0.001	-0.001	-0.001
Copper	3	-0.001	0.004	0.003
Iron, Total	3	0.56	23.9	7.4
Iron, Dissolved	3	0.46	2.15	1.45
Magnesium	3	2.41	6.13	4.12
Manganese, Total	5	0.023	0.166	0.066
Manganese, Dissolved	5	0.016	0.145	0.048
Mercury	3	-0.0001	-0.001	-0.0004
Molybdenum	3	-0.01	-0.01	-0.01
Nickel	3	-0.01	-0.01	-0.01
Potassium	3	9.58	45.3	21.7
Selenium	3	-0.001	-0.001	-0.001
Sodium	3	14.1	75.7	47.9
Strontium	3	0.07	0.26	0.17
Zinc	3	0.019	0.086	0.045

* Concentrations in mg/l unless otherwise noted.

"-" means less than.

[1] Numerical average or indicator if values less than detection were reported.

Exceedences of the acid of ferruginous mine drainage standards (Appendix G) were observed in the 1979-1983 period at all of the creek stations. Most of these exceedences were related to total suspended solids concentrations. Cummins, Jones and Shaw Creeks, at least in one instance, showed iron concentrations higher than the standards and some pH readings below 6.0. Manganese was not observed to exceed the standards at any station.

During high-flow conditions in Cummins Creek, observed concentrations of dissolved oxygen, chloride, sulfate, total dissolved solids, alkalinity, hardness, acidity and organic nitrogen were lower than concentrations observed for low flows. Conductivity and pH values were observed to be less than or equal to low flow concentrations. Constituents that showed higher concentrations during high flows were ammonia, nitrogen, color, turbidity, phosphate, total suspended solids and fecal coliforms. Iron and manganese were also found to be higher during high flow conditions but did not exceed mine drainage standards.

Stream standards for Segment 1402 do not apply to intermittent streams. However, they can be used as a basis for evaluating water quality because they protect designated water uses downstream. All four summarized creek stations showed dissolved oxygen concentrations below 5.0 mg/l, the segment standard. Cummins and Jones Creeks showed chloride and sulfate concentrations above the segment standard of 100 and 75 mg/l, respectively, as well as fecal coliform numbers exceeding 200/100 ml standard.

Cummins Creek showed total dissolved solids concentrations above the segment standard of 500 mg/l. Shaw Creek showed concentrations of sulfate above the segment standard of 75 mg/l and fecal coliform numbers above the 200/100 ml standard.

Pertinent trace metals concentrations observed in the creek monitoring were compared to Texas standards for persistent toxicants (in this case one-twentieth of the 96 hour median lethal concentration or LC_{50} for Bluegill Sunfish) and EPA criteria for protection of freshwater aquatic life at average hardness values (Appendix G). Only cadmium and mercury showed any elevated values, although assay detection limits were sometimes above standards concentrations precluding comparison (see Tables 3-41 through 3-44).

Radioactive levels have been surveyed in Texas Surface Waters (Drynan and Gloyna, 1960). The general level of surface water radioactivity was found to be relatively lower and less variable in the Colorado River Basin than most other large basins. No excessively high concentrations of beta radioactivity were found in any of the basin's 327 samples analyzed. No alpha activity was found to indicate the possibility of natural deposits contributing to surface water radioactivity. The study included samples taken from the Colorado River in Bastrop and Colorado Counties, above and below the project area, respectively. Values for Bastrop County were 12.0 pCi/L average suspended gross beta radioactivity and 10.58 pCi/L average dissolved gross beta radioactivity. Values for Colorado County were 14.25 pCi/L average suspended gross beta radioactivity. These values are consistent with the rest of the basin representing low background radioactivity. Natural dissolved uranium values for the Colorado River Station at Columbus (see Table 3-39) averaged only .001 mg/l. Insufficient water quality data were available to summarize the status of the intermittent streams, Cedar or Clear Creek. These would be located in the Fayette Power Plant and conveyor areas, respectively.

Water quality data have been collected since January 1980 for well locations of interest to the Cummins Creek Project including water quality from the sands between 6400 and 5500 lignite horizons and the 3500 and 2500 seams, where seepage to the mine pit is expected (Table 3-45).

The water quality expected of seepage from the sands between 6500 and 5500 lignite horizons has a high probability of exceeding acid mine discharge limitations. Water from sand between the 3500 and 2500 seams has a moderate probability of exceeding acid mine discharge limitations.

Potential problems will likely be related to high iron concentrations and low pH. Mixing of pit discharges with surface runoff in the sediment ponds may alleviate these problems; however, treatment could be required to meet discharge limitations of the sediment ponds.

Trace metals concentrations in the groundwater samples were compared to primary drinking water maximum concentrations where detection limits were low enough (Appendix G). High values were observed in samples from the 3500 and 2500 sands for cadmium, chromium, lead, manganese, mercury, and selenium. High values were observed in samples from the 6500 and 5500 sands for arsenic, cadmium, chromium, manganese, mercury, and zinc.

Mine Construction and Operation

The proposed mine covers an area stretching from the community of Nechanitz north to U.S. Highway 290, with the mine operation advancing from south to north for a period of 36 years. Reclamation and mining activities would be conducted simultaneously to minimize the time an area is exposed to wind or water erosion. Erosion and sedimentation control would be implemented throughout the mining operation. This would include the diversion of water from undisturbed land areas around the disturbed surfaces as well as routine monitoring and maintenance of construction areas by qualified on-site personnel. Riprapping, mulching, and other corrective measures would be used as necessary. Water from disturbed land and groundwater removed from the mine pits would be treated by a series of sedimentation ponds.

Runoff peak flows and volumes for the 10-year, 24-hour storm were calculated for each watershed and associated mining pits using a watershed hydrology simulation program (SCS, 1965). Rainfall values for this and other storms were obtained from the U.S. Weather Bureau Technical Publication No. 40. Table 3-46a summarizes the parameters for various storms used in designs of the water control system.

TABLE 3-45

CUMMINS CREEK MINE
GROUNDWATER QUALITY

		6500-5500 Sands				3500-2500 Sands			
Parameters	Units	Number of Samples	Minimum Values	Maximum Values	Means[1]	Number of Samples	Minimum Values	Maximum Values	Mean[1]
pH	units	95	3.5	6.4	5.25	46	4.9	6.6	5.7
Arsenic, Dissolved	mg/l	94	-0.001	0.429	0.015	45	-0.001	-0.01	0.009
Calcium, Dissolved	mg/l	86	1.0	253	67.83	40	7.2	105	28
Magnesium, Dissolved	mg/l	85	1.6	80.4	13.23	40	1.61	17.4	4.24
Sodium, Dissolved	mg/l	86	5.8	272	95.9	40	39.9	148	14.1
Potassium, Dissolved	mg/l	86	1	20	10.14	40	4.6	12	6.97
Bicarbonate	mg/l	75	0	945	179.2	32	0	110	21.9
Sulfate	mg/l	94	0	1,150	191.4	46	19	367	67
Chloride, Dissolved	mg/l	94	6.4	376	161.7	46	34	131	69.6
Flouride	mg/l	94	0.08	28	1.01	46	0.08	0.86	0.29
Nitrate	mg/l	94	-0.01	1.72	0.01	46	-0.01	0.67	016
Total Dissolved Solids	mg/l	93	70	1,770	697	46	267	959	408
Aluminum, Dissolved	mg/l	93	-0.01	14	0.787	46	-0.01	0.39	0.043
Cadmium, Dissolved	mg/l	94	-0.001	-0.1	0.020	45	-0.001	0.1	0.027
Chromium, Dissolved	mg/l	94	-0.001	0.110	0.031	46	-0.001	0.27	0.056
Copper, Dissolved	mg/l	94	-0.001	0.32	0.023	46	-0.001	-0.1	0.034
Iron, Dissolved	mg/l	94	-0.01	122	5.79	46	-0.01	9.4	1.62
Lead, Dissolved	mg/l	94	0.001	-0.08	0.012	46	-0.005	0.5	0.032
Manganese, Dissolved	mg/l	94	0.025	2.04	0.434	46	-0.034	0.325	0.126
Mercury, Total	mg/l	94	-0.0001	-0.05	0.005	46	-0.0001	-0.05	0.008
Molybdenum, Dissolved	mg/l	94	-0.001	0.1	0.026	46	-0.01	0.1	0.01
Nickel, Dissolved	mg/l	94	-0.01	0.55	0.078	46	-0.01	0.04	0.04
Selenium, Dissolved	mg/l	94	-0.001	-0.15	0.003	46	-0.001	-0.15	0.247
Zinc, Dissolved	mg/l	94	0.015	5.64	0.257	45	0.008	0.344	0.007

"-" Means less than.

1 Numerical average

TABLE 3-46a

CUMMINS CREEK MINE
STORM EVENTS USED FOR THE DETERMINATION OF CRITICAL FLOW RATES AND VOLUMES OF RUNOFF

Return Period Years	Duration Hour	Depth of Rainfall Inches
10	24	7.2
25	24	8.6
100	6	7.7
100	24	11.0

Peak flows and runoff volumes for selected watershed locations, in and about the mine, are listed in the mine permit application (LCRA, 1984d). The diversion and sediment ponds, as well as the diversion or control ditches, were designed to accommodate the maximum flow rates for the 10-year 24-hour design storm.

Sediment storage requirements for each pond were developed by assigning 0.1 acre-feet of storage for each acre of disturbed land according to Section 051.07.04.344(b)(2) of the Texas Mining Regulation (RRC, 1983). An additional volume of 0.035 acre-feet per acre of undisturbed land was included. This storage volume was considered to be adequate for the life of the ponds and was used in their design along with runoff and pit inflows.

The present water control plans indicates 37 ponds ranging in size from 6 to 2,013 acre-feet would be built during the life of the project. Nineteen of these ponds are for control of disturbed runoff and sediments, and 18 ponds are for control of undisturbed runoff and flood flows. The water control plan also anticipates the construction of 23 major ditches throughout the project life. Four of these are to convey disturbed runoff to sediment ponds, and the other 19 are proposed to divert undisturbed runoff around active mining or reclamation areas. LCRA's water control plan is summarized in Table 3-46b.

For water control planning purposes, the mine area was divided into seven 5-year blocks, with the last block having one extra year of mining (Figures 3-12 through 3-18). The first block also covers the start-up period and pre-mining construction activities. Each of the 5-year periods show the open pit that would be in operation at the end of each mining block. That pit, defined by the crest of the leading BWE bench and by the final spreader advance on the north and south, respectively, very closely approximates the extent of the area mined during the 5-year period of that block. The pit is bounded on the west by the mining subcrop and on the east by the downdip extent of mining. Clearing and grubbing would proceed approximately one year ahead of the mine pit. A spreader line was used to schedule the timing for removal of water control structures and to schedule the diversion of Cummins Creek. The structures

TABLE 3-46a

CUMMINS CREEK MINE
STORM EVENTS USED FOR THE DETERMINATION OF CRITICAL FLOW RATES AND VOLUMES OF RUNOFF

Return Period Years	Duration Hour	Depth of Rainfall Inches
10	24	7.2
25	24	8.6
100	6	7.7
100	24	11.0

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TABLE 3-46a

CUMMINS CREEK MINE
STORM EVENTS USED FOR THE DETERMINATION OF CRITICAL FLOW RATES AND VOLUMES OF RUNOFF

Return Period Years	Duration Hour	Depth of Rainfall Inches
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25	24	8.6
100	6	7.7
100	24	11.0

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Sediment storage requirements for each pond were developed by assigning 0.1 acre-feet of storage for each acre of disturbed land according to Section 051.07.04.344(b)(2) of the Texas Mining Regulation (RRC, 1983). An additional volume of 0.035 acre-feet per acre of undisturbed land was included. This storage volume was considered to be adequate for the life of the ponds and was used in their design along with runoff and pit inflows.

The present water control plans indicates 37 ponds ranging in size from 6 to 2,013 acre-feet would be built during the life of the project. Nineteen of these ponds are for control of disturbed runoff and sediments, and 18 ponds are for control of undisturbed runoff and flood flows. The water control plan also anticipates the construction of 23 major ditches throughout the project life. Four of these are to convey disturbed runoff to sediment ponds, and the other 19 are proposed to divert undisturbed runoff around active mining or reclamation areas. LCRA's water control plan is summarized in Table 3-46b.

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Table 3-46b

Water Control Plan for Cummins Creek Mine

MINE BLOCKS	WATER CONTROL STRUCTURES[1]	WATERSHED/DRAINAGE AREAS	PURPOSE/PROJECT AREAS
One	DP-1, DP-2, DD-1, DD-2	Rabbs Creek & Jones Creek	Route undisturbed runoff east of mine and reduce undisturbed runoff entering SP- 2.
	SP-1, CD-1	Rabbs Creek	Control runoff and sediment from topsoil spoil pile C and runoff entering mine pits.
	SP-2, SP-2A, SP-3, SP-4 SP-5	Rabbs Creek headwaters	Control runoff from initial dragline mining areas and from permanent overburden stockpile.
	SP-9 (Existing SCS #9)	Cummins Creek	Control runoff from disturbed area in headwaters of Shaw Creek and runoff from topsoil stockpile.
	DP-3	Cummins Creek	Retain undisturbed runoff that would otherwise go into SP-9.
	SP-10 (Existing SCS #5)	Turkey Creek	Control water from headwaters of Turkey Creek
	SP-9, SP-10	Turkey Creek	Control runoff and sediment from topsoil stockpiles D,G,&H.
	DD-16, DD-17	Turkey Creek	Route undisturbed runoff south & west of mine to SP-9 & SP-10.
	SP-6C, SP-7B	Turkey Creek	Control runoff from facilities site and lignite stockpile.
	SP-12, DD-9	Turkey Creek headwaters	Intercept runoff before entering mine pit, & dragline area.
	DD-18	Turkey Creek	Route runoff from Dragline area to SP-5.
Two[2]	DD-19	Turkey Creek	Direct disturbed area runoff to SP-10, or intercept water which would otherwise enter SP-10.
Three	SP-13A, SP-14A, SP-11A	Cummins Creek	Reduce sediment entering SP-10 (SP-11 would be used in later diversion of Cummins Creek) & mine pit.
	CD-2 (Formerly DD-9)	Cummins Creek	Serve as emergency spillway for SP-11A.
	SP-10 B	Cummins Creek	Prevent Water in SP-10 from entering the mine pit.
	DD-4, DP-7	Cummins Creek	Implement the Oxbow Bypass Diversion of Cummins Creek until it is mined through.
	SP-18	Cummins Creek	Control runoff from disturbed areas.
	DP-6	Alexander Branch Creek	Control some disturbed land and discharges into SP-18.
	DP-4, DP-5	Alexander Branch & Pin Oak Creeks	Regulate flood flows, and later become a part of the Cummins Creek Diversion.
	DD-5	Cummins Creek	Divert undisturbed runoff from mine into SP-10.

1 - SP=Sediment Pond, DP= Diversion Pond, DD= Diversion Ditch, CD=Control Ditch.

2 - Ponds built during Block One would still be in operation. Mining and reclamation within this time period is expected to be the most extensive throughout the life of the proposed project.

Table 3-44b Continued

MINE BLOCKS	WATER CONTROL STRUCTURES	WATERSHED/DRAINAGE AREAS	PURPOSE/PROJECT AREAS
Four	DP-4, DP-5, DP-9, DP-12 DP-11 (Existing SCS #4) DD-6, DD-8	Cummins Creek	Create temporary diversion of Cummins Creek until mining is complete on this Block.
	SP-16, SP-17	Turkey Creek	Control drainage downstream from SP-11A.
	SP-19, SP-6A	Turkey Creek (reclaimed spoil)	Regulate flows and reduce storage requirements in SP-10.
	SP-20	Cummins Creek	Principal runoff and sediment control unit for active mining and reclamation areas.
	SP-20B	Cummins Creek	Prevent water from flowing into mine pit from SP-20.
Five[3]	DP-4, DP-5, DP-9 DD-3, DD-9 (Formerly CD-2)	Cummins Creek, Alexander Branch & Pin Oak Creeks	Reversed direction of flow to route around south side of mining and reclamation (i.e. Cummins Creek Diversion).
	DP-19, DP-19B, DD-20 DP-8, CD-5	Cummins Creek	Route runoff to SP-20.
	DP-15, DP-16, DP-17, DD-10, DD-11, DD-12	Cummins Creek, Violets & Flat Creeks	Divert Violets Creek, when DP-11 (Existing SCS #4) is removed, to drain into DP-12 and Flat Creek.
	DD-13	Upper Mile Creek	Route undisturbed runoff to DP-9.
	DP-14	Upper Mile Creek	Control runoff downstream from DD-13.
Six[4]	DP-18	Violets Creek headwaters	Intercept runoff from undisturbed drainage north of mine pit.
	DD-14	Violets Creek	Route water around mine into Flat Creek below SCS #6.
	DD-13	Violets Creek	Intercept runoff from undisturbed areas west of Violets Creek and north of mine, and route to Cummins Creek diversion.
Seven	DD-15	Cummins Creek	Route runoff from undisturbed drainages north of project area around the mine to Cummins Creek.
	DP-12	Cummins Creek	Control runoff from areas still under reclamation.
	DD-14	Cummins Creek	Intercept runoff from undisturbed watersheds north of mine and route to Flat Creek.
	SP-20 & Cummins Creek Diversion	Cummins Creek	To be removed when mine area, excluding the End Lake, had been released from bond.
	DP-9	Cummins Creek	Not to be removed, but used to direct flow from Cummins Creek drainage above mine into the End Lake.
	End Lake	Cummins Creek	Flood Control Structure to replace SCS #4.

[3] - Includes final Cummins Creek Diversion; SP-20 remains principal control unit for active mining and reclamation area.

[4] - SP-20 would remain principal control unit; Cummins Creek channel would nearly be reclaimed by mine year 30, allowing removal of SP-20B.

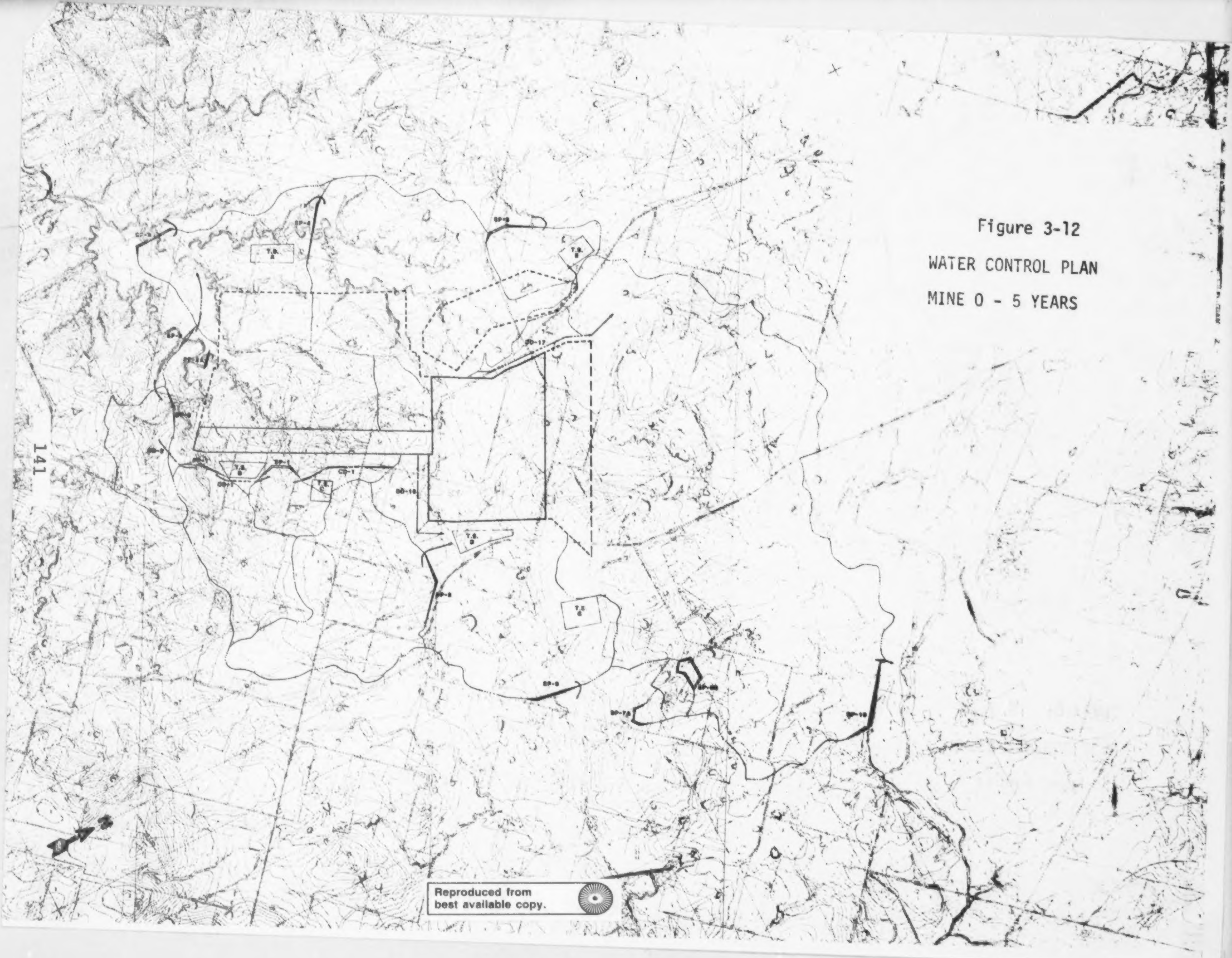
T.S. A
SP-4
T.S. B
SP-1
CD-1
DD-1
T.S. C
DD-10
T.S. D
DD-17

Figure 3-12

WATER CONTROL PLAN

MINE 0 - 5 YEARS

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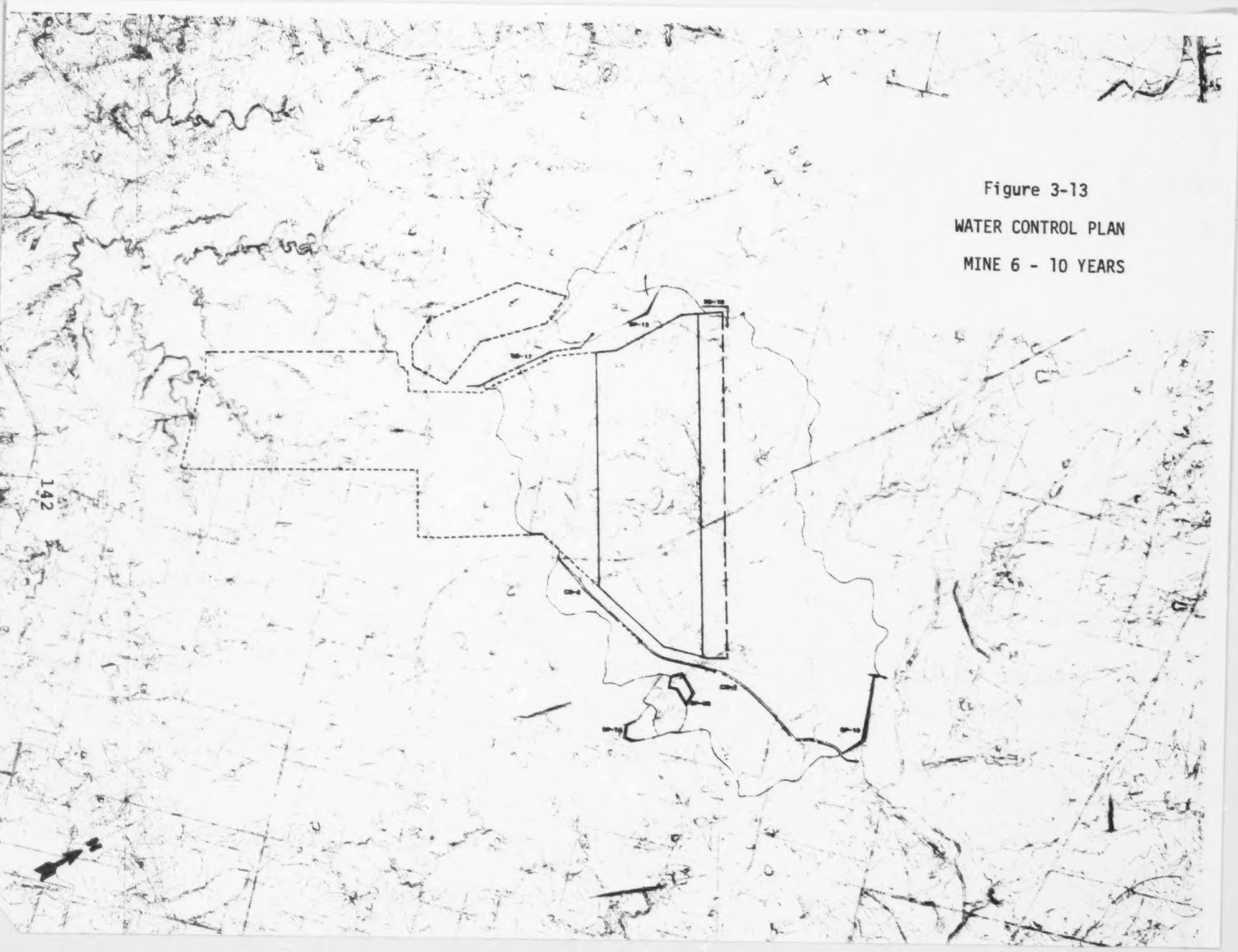

Figure 3-13

WATER CONTROL PLAN

MINE 6 - 10 YEARS

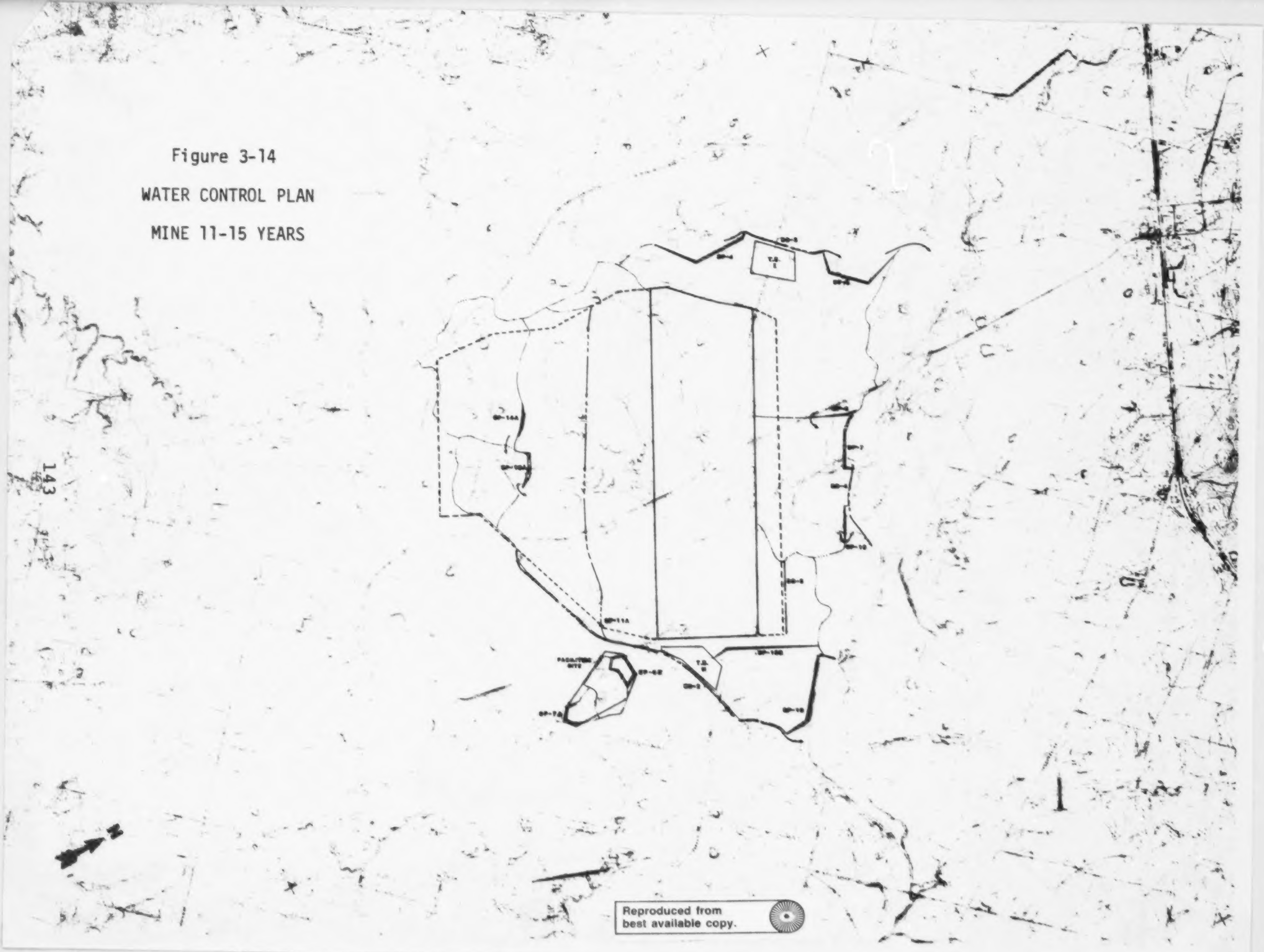
SP-11A
SP-7A
T.S.
T.S.

Figure 3-14

WATER CONTROL PLAN

MINE 11-15 YEARS

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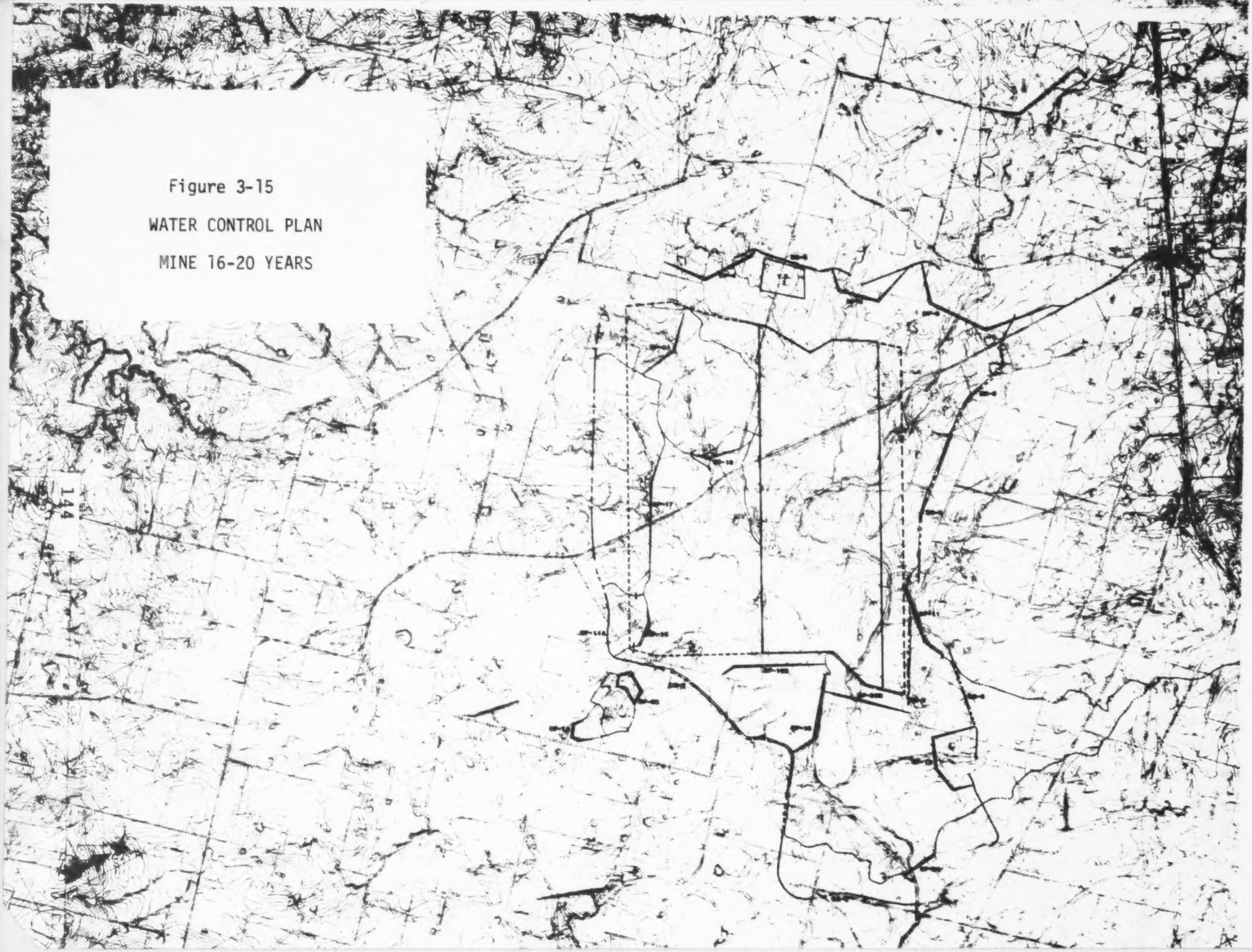

Figure 3-15

WATER CONTROL PLAN

MINE 16-20 YEARS

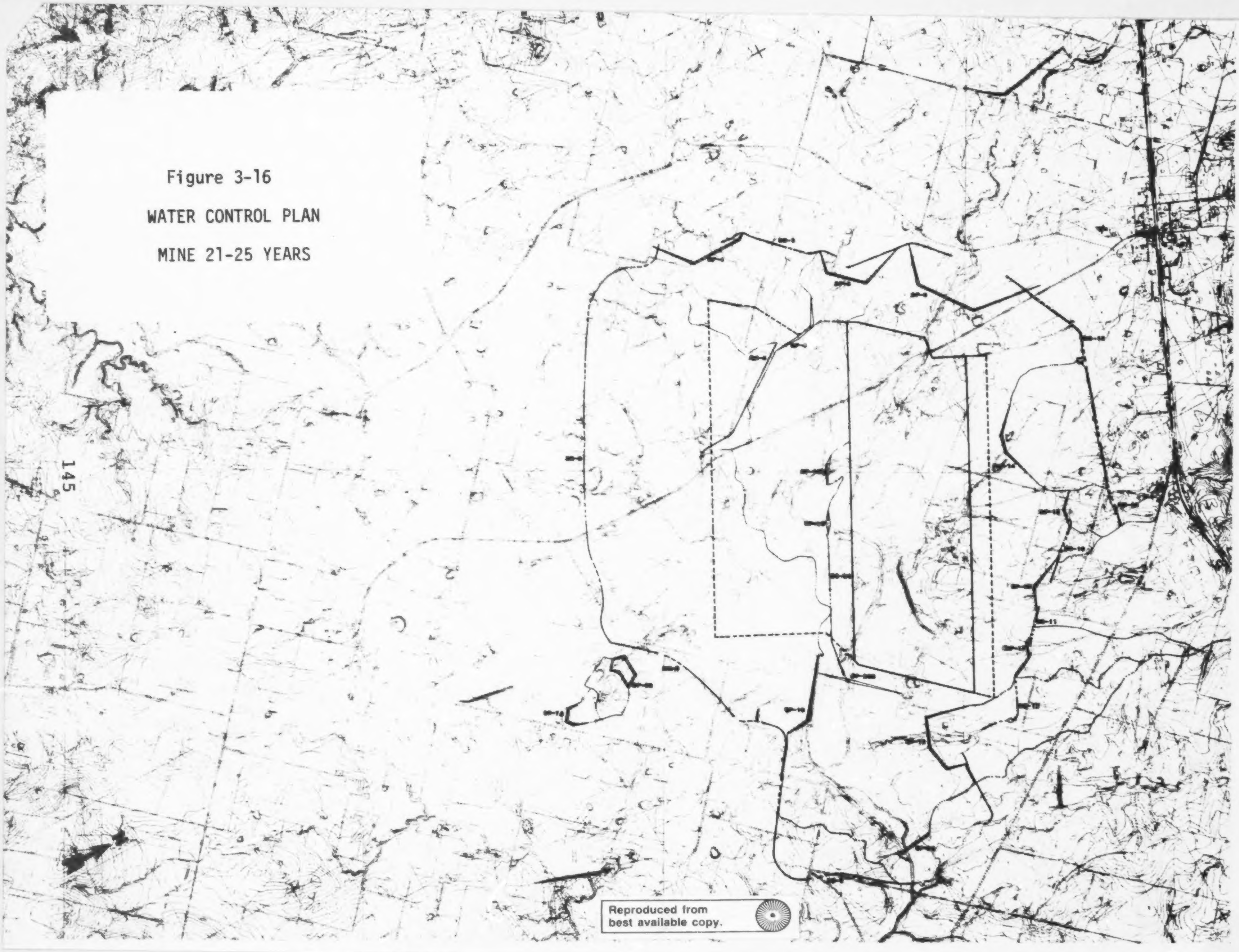

Figure 3-16

WATER CONTROL PLAN

MINE 21-25 YEARS

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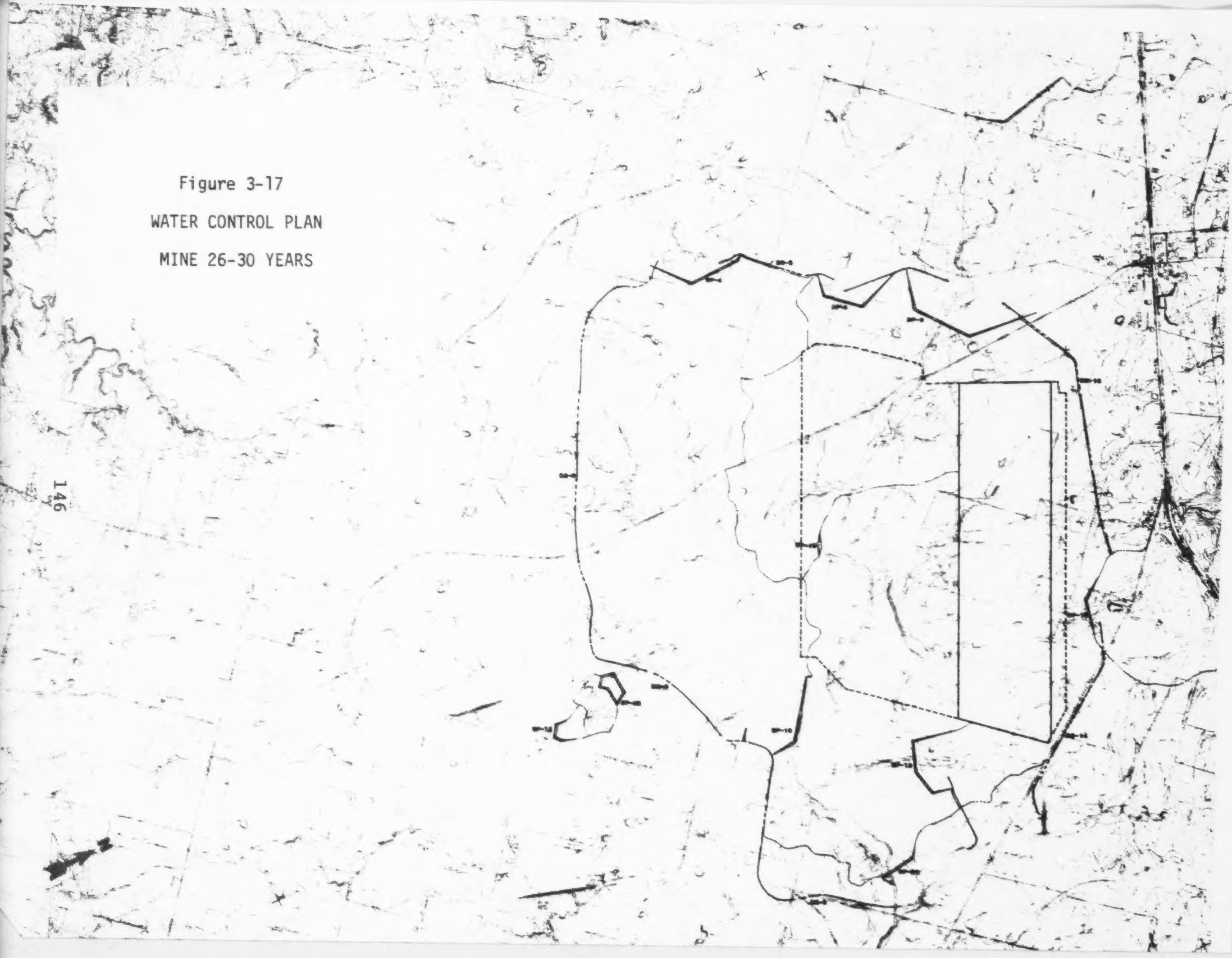


Figure 3-17

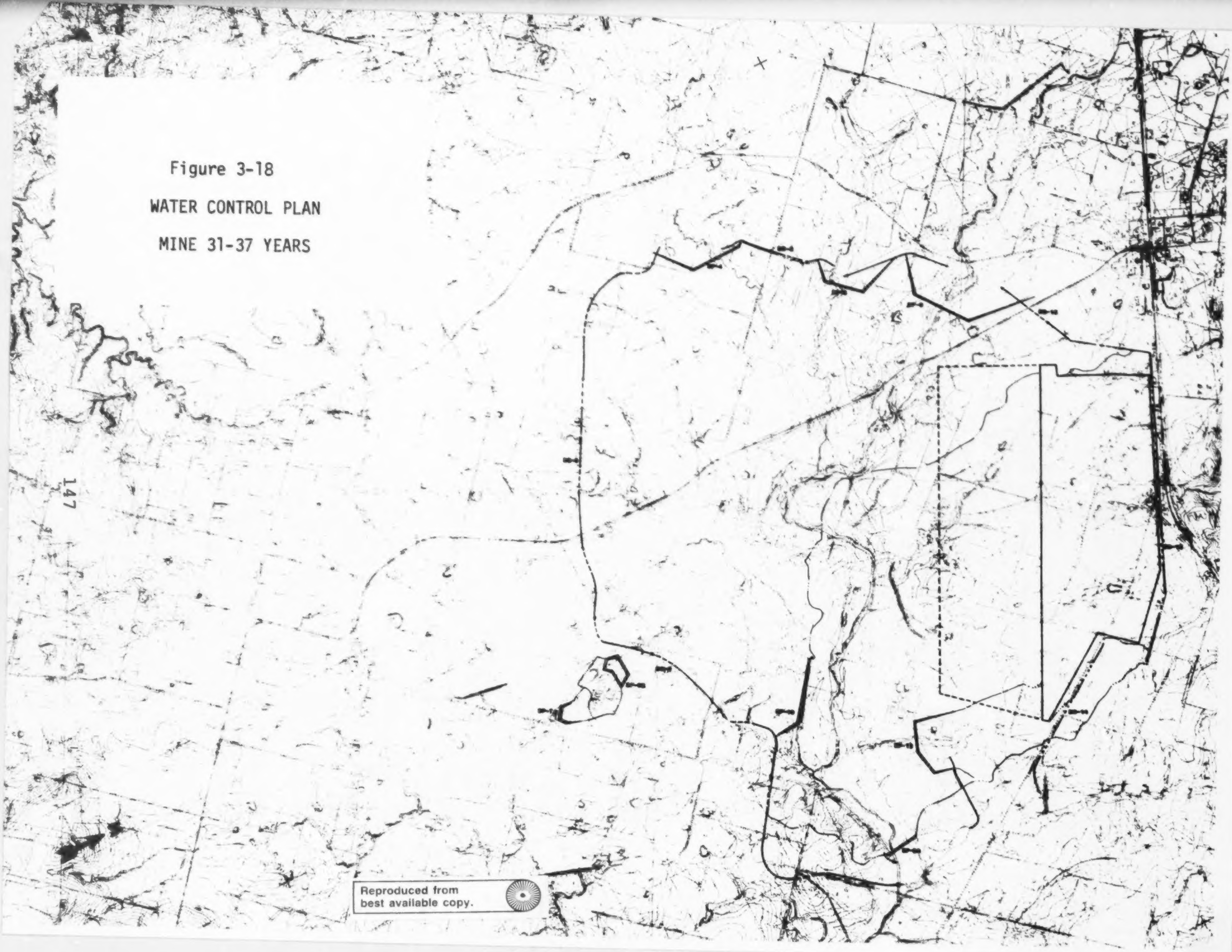
WATER CONTROL PLAN

MINE 26-30 YEARS

Figure 3-18

WATER CONTROL PLAN

MINE 31-37 YEARS



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required to control runoff from other features of the project (permanent overburden stockpile, topsoil stockpiles, etc.) are also shown.

Dewatering Requirements

The dewatering requirements from groundwater seepage into the mine are determined by the rates and volumes that will enter through exposed sand faces. The areal extent and characteristics of the parting sands indicate that dewatering is quite feasible by allowing seepage along the highwall. Pit inflows would be directed along the benches and pit floor to sumps. From the sumps, the seepage water would be pumped to surface sediment ponds.

Average daily seepage rates during the permit term of the mine will be highly variable due to the gradual exposure of the sands, their variability in thickness, and variability in water-bearing characteristics. Daily flow rates have been estimated to range from a few hundred to 2.0×10^6 gpd. The maximum daily flow rate is equivalent to 3.7 cfs. During the first 3 years of mining, pit seepage is expected to be negligible, increasing significantly in Mining Year 4 and generally increasing to 2.0×10^6 gpd during Mining Year 10.

Maximum inflows could be encountered in approximately two-thirds of the downdip pits. It is in this area where the pits would be deepest and, therefore, expose more of the sands. Also, the deeper sands contain water that is under relatively high pressure, which would contribute the greater amount of seepage.

Additional storage requirements in the runoff/sediment retention system were calculated by projecting the critical period of time when the design storm could occur, and the ground water pit inflows would be retained in addition to the surface runoff.

This critical period was conservatively estimated to be 15 days. Using the maximum expected flow rate of 2.0×10^6 gpd, the projected maximum amount of pit inflows from groundwater over this time period would be 92 acre-feet.

Depressurization requirements for sands below the 2500 lignite seam were estimated based on the amount of pressure and thickness of these sands (See Section 3.5.2). Wells were designed and located above the end walls of the pit and on the 5500 bench following BWE #2 parallel to the highwall. Each well group would concentrate on the downdip end of the mine where the highest pumping rates would be required.

The volume of water from the depressurization operation is expected to range from 1.9×10^5 to 3.9×10^5 gpd. No adjustment to pond sizes is anticipated to handle this extra water.

The volumes of runoff accumulated in the pit from surface runoff and direct rainfall from the occurrence of the 10-year, 24-hour storm were calculated for each mining block. The runoff/sediment retention system was sized to store these pit inflows as well as seepage volumes. This water would be pumped to the sediment ponds in a reasonable period of time after the storm event.

Water which enters the pit, either through direct rainfall and runoff or from groundwater would be removed. This water would contain suspended solids and potentially could have lower pH and higher electrical conductivity than normal surface waters. The waters would be pumped into sedimentation ponds and, if necessary, treated to meet discharge standards.

Mine Discharges

The project's proposed effluents are described as discharges from: 1) the pond receiving wastewater from the mine facilities and storm runoff from the lignite handling facilities; 2) ponds receiving surface water and groundwater from the mine; and 3) ponds receiving only surface water and storm runoff from the mine. The constituents of these discharges are estimated on the basis of existing monitoring data and current knowledge of mining practices (Table 3-47).

Predictions for unregulated constituents (trace metals and radiochemicals) are more uncertain than for those usually permitted in the mining process (i.e. pH, total iron, total manganese, and total suspended solids). Leaching potential is evaluated in the Groundwater Section for the overburden and lignite.

Special concern has been given to radioactive materials. Studies by Kaiser (1976) have indicated that north and central Texas lignites contain 3.0 to 25.5 ppm by weight of uranium. Jackson lignites from the San Miguel Mine (probably the closest analogy for the Cummins Creek project) had uranium and thorium contents of 5.0 and 7.0 ppm by weight, respectively (Tippett and Gee, 1976). For comparison, the uranium content of typical Texas uranium ore deposit is 1600 ppm, limestone is 1.3 ppm and ocean water is 0.003 ppm.

Initial studies by LCRA utilized downhole gamma probe and laboratory analyses of lignite and overburden to determine if any lignite or overburden horizons in the Cummins Creek Project Area showed radionuclide concentrations higher than would be expected in normal soil horizons. The Cummins Creek lignite samples yielded the following concentrations within the range of normal soil samples:

Uranium (ppm by Wt)	Thorium (ppm by Wt)	Radium 226(PCi/g)
52 samples	20 samples	28 samples
(1.7-10)$\overline{x}$= 3.5	(.1-17)$\overline{x}$= 2.3	(.5-3.5)$\overline{x}$= 1.5

The 641 gamma log responses above background levels were distributed by gamma counts per second in the following manner:

Background 120	120-200	200-400	400-600	600-2000
75.5%	13.7%	8.1%	1.4%	1.2%

TABLE 3-47

CHARACTERISTICS OF PERMITTED DISCHARGES

TYPE I

WASTEWATER FROM NINE FACILITIES AND STORM RUNOFF FROM THE LIGNITE HANDLING FACILITIES

Color
Ammonia
Organic Nitrogen
Phosphorus
Sulfate
Chloride
Fluoride
Aluminum
Calcium

Fecal coliform bacteria
Copper
Iron
Lead
Magnesium
Manganese
Potassium
Sodium
Zinc

TYPE II

PONDS RECEIVING SURFACE WATER AND STORE RUNOFF ONLY FROM THE MINE

Color
Ammonia
Organic Nitrogen
Nitrate
Phosphorus
Sulfate
Chloride
Fluoride
Aluminum
Calcium

Fecal coliform bacteria
Cooper
Iron
Lead
Mangesium
Manganese
Potassium
Sodium
Sodium
Zinc

TYPE III

PONDS RECEIVING SURFACE WATER AND GROUNDWATER FROM THE MINE

Color
Ammonia
Organic Nitrogen
Nitrate
Phosphorus
Sulfate
Chloride
Fluoride
Aluminum
Arsenic
Cadmium
Calcium
Chromium
Fecal coliform bacteria

Copper
Iron
Lea
Magnesium
Manganese
Mercury
Molybdenum
Selenium
Potassium
Sodium
Zinc

Assessment of the geologic data base helped determine the occurrence, relative magnitude, and origin of the gamma log anomalies observed. The gamma anomalies were concentrated in the southwestern portion of the mine area where weathering depths are roughly twice as deep as the the northeastern half due to more superficially exposed and permeable sands. The gamma anomalies are a near surface phenomenon usually occurring at relatively constant depth.

Volcanic ash of the Catahoula Formation is the presumed source of the uranium deposits in the Texas Coastal Plain. After this deposition, oxygenated surface water and groundwater leached the radionuclides into the underlying Whitsett sands where they migrated downward until they encountered the reduced lignite of the Whitsett and Manning Formations and precipitated out (See Section 3.6). The dip oriented cross sections from the project area indicate that the first partially oxidized-partially reduced interfaces where radionuclides deposited are either carbonaceous clay or partially weathered lignite.

An additional drilling and logging program, including both a calibrated gamma probe and the Princeton Gamma-Tech Geophysical Service (PGT) downhole radionuclide probe system, was later performed. A total of 27 holes, encompassing the range of gamma readings observed during the previous study, were drilled and logged. Readings from 19 holes (70%) were high enough to calculate uranium, thorium and daughter by product concentrations.

Two one-foot thick horizons (the 24-foot horizon in Hole 279-1F3 and the 22 foot horizon in Hole 279-2F1) yielded uranium concentrations of 658 and 693 ppm, respectively (in excess of 0.06%). For comparison purposes, 0.07% was an approximate lower cutoff for surface mining in Texas during the late 1970's and early 1980's when uranium ore prices were higher and where the ore was relatively thick and extensive, neither of which appears to be the case here.

All available geologic data confirms the presence of the radionuclides in the overburden or spoil material, and not in reduced mineable lignite. The vast majority of gamma anomalies occur in oxidized, unmineable lignites and the radionuclides appear to follow the lignite weathering profile. In very few cases the gamma anomaly appears to be concentrated in the partly oxidized carbonaceous clay roof overlying a reduced marketable lignite. In these few cases, careful removal of roof material overlying the lignite would be necessary to eliminate the possibility of contaminating the lignite delivered to the power plant.

Leaching of radiochemicals could occur but appears to be unlikely. The anomalous "radioactive" zones have an average thickness of 2 feet and are most common in one part of Mining Area 2 directly above the 5500 and/or 6500 lignite seams. The zones presently exist under reducing conditions. It is possible that the uranium bearing overburden could be placed in an oxidizing environment with sufficient water and other factors present to mobilize some of the uranium and increase the overall leachable uranium content.

However, much of the material would go directly back into the pit as part of the normal mining process and would be buried underneath other burden material. Uranium that is leached and mobilized will enter the groundwater. Since flow from Mine Area #2 is back into the main mine area, and since the uranium will reprecipitate under reducing conditions, the minimal amount of uranium mobilized would be undetectable compared to background levels in areas downdip of the mine. Other trace elements such as arsenic, beryllium, selenium and molybdenum are also often found with uranium at, or in the vicinity of, the oxidized-reduced contact. Generally, these materials are dissolved and precipitated under the same physiocochemical conditions which are the cause of the solution and precipitation of uranium. Presence of these elements around uranium "roll fronts" has been observed in Karnes and Live Oak Counties of Texas and in the Gas Hills and Shirley Basin area of Wyoming.

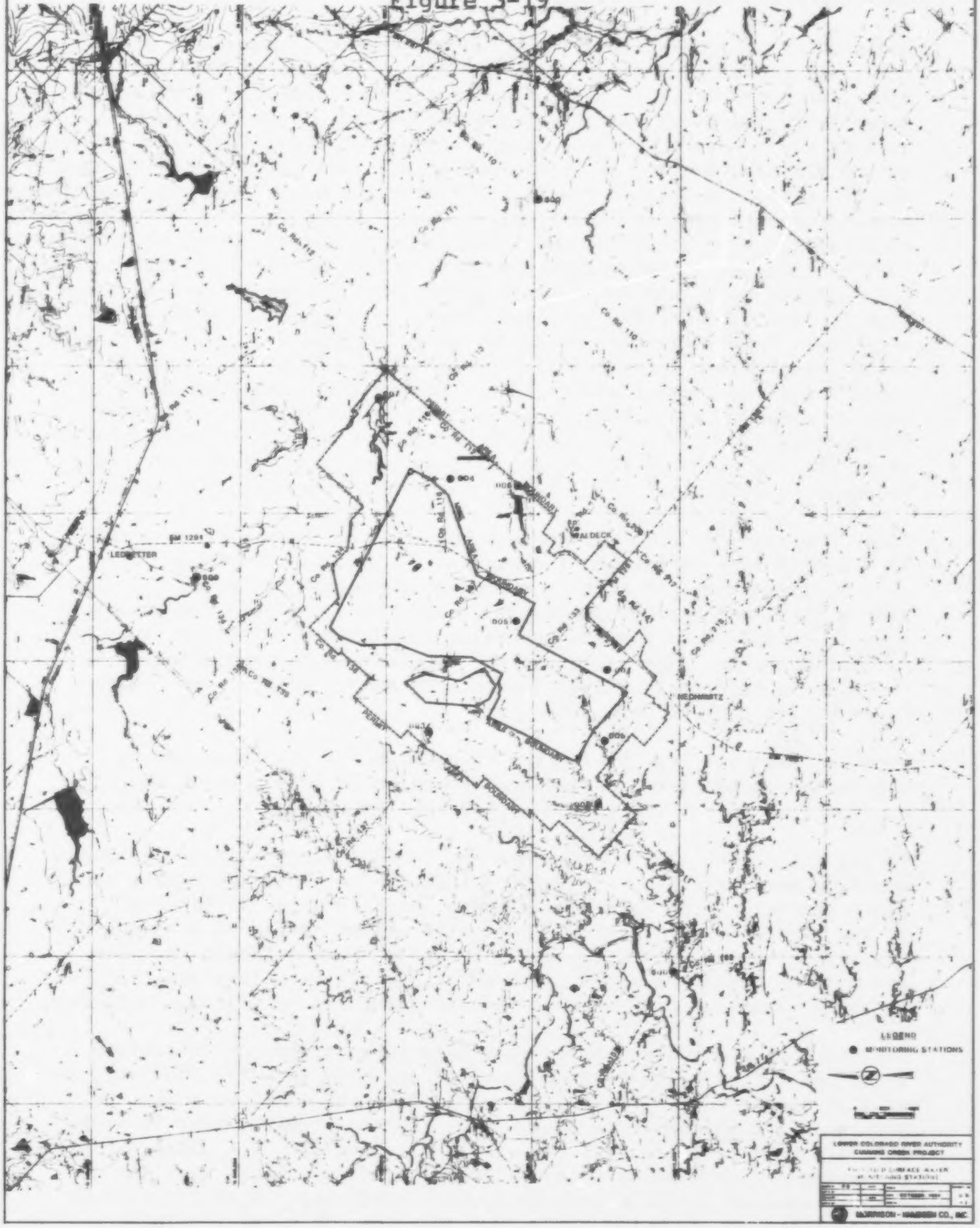
Those trace elements, which are found in the Cummins Creek area in concentrations at, or below normal soil level, would require no special handling. The combination of mixing of overburden during removal, burial below the oxidation zones, and extremely low concentrations would virtually eliminate the possibility that these elements could be transported outside of the mine boundaries in the ground water either underground or as pit water pumped to the sediment ponds.

Most sediment carried by storm runoff would be treated by settling unless the discharge is greater than the capacity of the ponds (designed to retain one 10-year, 24-hour storm). The possibility of such an overflow is small and it is anticipated most runoff would meet the discharge limits for pH, total suspended solids, total iron and total manganese (TDWR, 1983). Trace metals are usually associated with suspended solids. Therefore, any potential hazard to designated water uses such as domestic water supply, contact recreation or wildlife propagation downstream in Segment 1402 of the Colorado River would be reduced by settling.

The chemical quality of the surface water, both within the mine plan area and in adjacent areas, is not expected to deteriorate as a result of the mining operations. Undisturbed water would be diverted around the active mining area in diversions constructed to allow it to meet or exceed the criteria of the Acid Mine Discharge Regulations. Water released from sedimentation ponds would be required to meet existing water quality standards prior to discharge. If acid forming materials are encountered in the overburden, the material would be treated or buried under nontoxic, noncombustible material. The existing baseline surface water monitoring program would be continued until the mine is operational.

The operational monitoring program would be expanded beyond the preoperational program. Monitoring of several water control sediment ponds would be a requirement of EPA's NPDES discharge permit (See Appendix A). The proposed operational monitoring program sampling locations are shown on Figure 3-19. The station numbers correspond to the NPDES serial serial numbers with the 100-series numbers representing the location of non-NPDES stations. Monitoring of the water quality and quantity would be done by LCRA at least quarterly. Parameters in addition to flow which would

Figure 3-19


LEDBETTER
FM 1291
WALDECK
NECHANITZ
Co Rd 110
Co Rd 111
Co Rd 112
Co Rd 113
Co Rd 117
Co Rd 119
Co Rd 133
Co Rd 135
Co Rd 141
Co Rd 215
004
005
006
008
LEGEND
MONITORING STATIONS
LOWER COLORADO RIVER AUTHORITY
CUMMINS CREEK PROJECT
PROPOSED SURFACE WATER
MONITORING STATIONS
OCTOBER 1984
MORRISON - KNUDSEN CO., INC.

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be monitored include pH, total suspended solids, settleable solids, total iron and total manganese.

Undisturbed surface water drainage would be routed around the mine area, and disturbed surface water would not be released from sedimentation ponds until it meets discharge permit limits. Nevertheless, unavoidable short-term adverse impacts of mining on surface water quality would result from increases in sediment production (soil erosion) during construction and mine development. Activities expected to cause the greatest potential increases are timber and brush clearing, road and pipeline relocations and construction, and excavation and grading during construction of drainage channels and sediment ponds. Other activities, such as local site preparation and construction of shop facilities, are expected to result in minor increases in sediment production and adverse impacts. Current available technology would be employed, as necessary, to minimize the potential adverse impacts of construction on runoff and surface water quality. Adverse impacts of mine-related construction on surface water of the project area should be minor in magnitude and of short-term duration. The actual change of quantity in local surface runoff will depend ultimately on the mining and backfill plan. As discussed in the groundwater section, peak flows and runoff volume will be greater on disturbed land than on undisturbed land.

After reclamation, LCRA may request that certain temporary structures be classified as permanent if requested by landowners. These water control structures, if left as permanent impoundments, would delay and reduce the immediate downstream flow quantities constituting long-term adverse impacts. Only minor decreases in the Colorado River flows due to mining are anticipated, since the total drainage area affected by the mine is less than 0.1% of the total drainage area of the Colorado River at the project site.

Vertical permeability is expected to be higher in the post-mining overburden, potentially increasing ground water infiltration which would act to offset the potential increase in runoff.

During the course of land reclamation, surface water drainage patterns would be reestablished. Deviations from the original topography would cause changes in the watershed divides, particularly in the area of the overburden stockpile. These alterations may cause portions of the surface runoff which currently flow into Cummins Creek to drain and flow out into the Rabbs Creek watershed. Alterations and transfer in these flows constitute minor long-term impacts on drainage patterns.

The end lake would cause major long-term adverse impacts on surface water quantities. Runoff from the land draining into the end lake, as well as Cummins Creek flows diverted to fill the lake, would not be available downstream in Cummins Creek. It is estimated that it would take 10 to 15 years to fill the end lake to the 370-foot above MSL elevation. A spillway and channel back to Cummins Creek near the eastern edge of the mine area would be established. When the lake is filled to spillway depth, controlled overflows from the end lake would be diverted back to the original streambed. During the filling period, flow in Cummins Creek should be maintained at approximately 0.5 cfs by pumping from the end lake.

The Cummins Creek channel would be re-established following mining. Although flow from the upper reaches at Cummins Creek (approximately 19 square miles) would be diverted at the western edge of the mine (see Figure 3-16) to fill the end lake, drainage from approximately five square miles in the immediate mine area would still flow through the reconstructed Cummins Creek channel within the mine area. Peak flows in the Cummins Creek channel immediately below the mine would thus be reduced by approximately 80 percent. An additional five to ten percent would be added by pumping from the end lake.

Once the end lake is constructed and in operation, it would act as a large flood-dampening reservoir in the Cummins Creek system. Overflows from the lake would not equal flows into the lake, the differential being related to ground-water recharge in the end lake area and evaporation from the end lake surface. These two factors would account for approximately 40 percent of the lake inflow (inflow both from Cummins Creek and from direct rainfall to the lake surface). Another 20 percent of the inflow would be required to raise the lake to spillway depth, so that approximately 40 percent would be released over time back into Cummins Creek. Using an annual input figure of 245 acre-feet of runoff per square mile of drainage, the flow volume in Cummins Creek (24 square miles) at the eastern edge of the mine area is currently approximately 5,899 acre-feet. With the end lake filled, the average annual flow would be a total of 3,458 acre-feet, or 59 percent of the present flow. Since Cummins Creek within or immediately downstream of the mine area is currently dry for much of the year, the eventual controlled releases and flood retention is considered a positive impact on the downstream drainage.

Worst-Case Impacts from the Mine In the water quality evaluation, EPA considered a worst-case situation in which aspects of the proposed action might have a maximum detrimental impact on downstream areas. This impact analysis (EPA, 1985) was done to determine if mining would produce a pollution increment in the event of a 24-hour 100-year storm that would impair the use of the Colorado River beyond what might occur without mining.

An initial screening was done to evaluate if water quality constituent concentrations with mining were potentially at least 20 percent greater than the concentrations without mining. If this threshold of potential significance was exceeded, then additional analysis was done to project resulting concentrations in runoff and sediment of the exceeding constituent. The 20 percent increment was selected based upon consideration of the water quality data accuracy and the conservative nature of current water quality standards criteria.

Constituents analyzed for runoff impact on the Colorado River were manganese, mercury, and sulfate from the Rabbs Creek watershed and arsenic, chromium, copper, iron, manganese, selenium, sulfate and zinc in the Cummins Creek Watershed. Constituents evaluated for sediment impact were cadmium, lead, manganese, molybdenum, selenium, and zinc for the Rabbs Creek Watershed which contains the permanent overburden spoils pile. A similar analysis was not necessary for the Cummins Creek Watershed. Summary Table 3-48 shows the resulting net water quality from the Rabbs and Cummins Creeks at their respective

TABLE 3-48
WORST CASE PROJECTIONS OF DISSOLVED QUALITY OF WATER REACHING THE COLORADO RIVER

Parameters are those which exceed threshold ratios. All values in mg/l

Constituent	Rabbs Creek	Cummins Creek	Most Restrictive EPA Water Quality Criteria[1]
Arsenic		0.002	0.05
Chromium		0.002	0.05
Copper		0.002	0.05
Fluoride		0.15	0.7
Iron		0.4	0.1
Manganese	0.02	0.05	0.05
Mercury	0.0002		0.0002
Selenium		0.001	0.01
Zinc		0.08	0.08

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1. Sources of criteria are EPA (1976), FWPCA (1968) and file data, EPA Region 6, Dallas, Texas.

Source: EPA, 1985.

points of discharge to the Colorado River. These net estimates assume only simple mixing of water from disturbed and undisturbed areas with no attenuation of the pollutants in transit. These values are compared to the most restrictive water-quality standards/criteria that could be applied to the Colorado River. This is truly a worst case because some of the criteria do not apply to short-term impacts from an extreme flood or current designated uses (i.e. irrigation).

The only constituent in runoff which exceeds criteria (drinking water and livestock use) is iron. The most recent criteria documents indicate that these standards are related to aesthetic considerations and in the case of livestock use, long-term phenomena. The use of surface water for drinking or livestock use would require treatment under present conditions (e.g., removal of suspended solids) and would be expected to control any iron problem, should the worst-case assumptions prove true.

Of those six constituents selected for further evaluation of sediment impacts (Table 3-49) molybdenum is the most mobile and therefore, the most likely to cause a problem. The calculation of the maximum potential leaching of molybdenum from the sediment indicates worst-case concentrations much less than have been reported to be of environmental concern.

Overland Conveyor Construction and Operation

Water control for the conveyor was designed to safely route stream and overland flows intercepted by the conveyor and adjacent access road. Borrow ditches would be provided on one or both sides as required. Culverts would be constructed where the access road will cross any intermittent or perennial streams.

No natural channel drainageways would be relocated for conveyor construction. The drainage structure has been designed that it should not affect the normal flow or gradient of the stream. The culverts have been designed to safely pass the 10-year 24-hour design event to eliminate flooding.

The operation of the overland conveyor would be above ground so that a short-term spill of lignite would be the worst case of potential pollution of the surface water. Due to the low probability and magnitude of this potential effect adverse impacts should be minor and short-term.

Fayette Power Plant Units 3 and 4 Construction and Operation

The Fayette Power Plant site is already occupied by Units 1 and 2 (600 MW each), their associated facilities and cooling reservoir, the Fayette County (Cedar Creek) Reservoir. Therefore, no land use change would occur to affect surface water in the Cedar Creek watershed. As with construction at the mine site, erosion and sedimentation would affect surface water quality, including potential for runoff and spills. These adverse construction impacts should be minimal and short-term.

TABLE 3-49

TRACE ELEMENTS IN SEDIMENT FROM DISTURBED AND UNDISTURBED PORTIONS RABBS CREEK[1]

* Indicate ratio exceeding 2.5:1.

Constituent (ppm)	Undisturbed [2]	Disturbed [3]	Ratio
Arsenic	7	10	1.4
Cadmium	0.01	2	200*
Chromium	11	24	2.2
Copper	9	20	2.2
Iron	5,000	510	0.1
Lead	2.6	26	10*
Manganese	60	314	5.3*
Molyldenum	0.2	5	25*
Selenium	0.3	1.3	4.3*
Uranium	1.7	1.6	1.1
Zinc	25	182	7.3*

---

1. EPA, 1985.

2. Conner and Shocklette, 1975.

3. Maximum concentration overburden spoil, based on LCRA (1984d, Table 3.3-1).

Discharges resulting from operation of the plant would leave the plant site via Cedar Creek and impact the Colorado River between La Grange and Columbus. Units 3 and 4 are additions to an existing facility so the evaluation of the surface water impacts will focus on changes in the existing permitted outfalls.

Outfall 101 - Recirculating Cooling Water

The major discharge from the power station to Cedar Creek Reservoir is the once-through condenser cooling water, which is normally identical to the water quality of the reservoir except for the addition of heat and small amounts of chlorine. With the addition of both Units 3 and 4, the once through condenser cooling water flow would be aproximately 1500 mgd.

Outfall 002 Low-Volume Wastewater (Oily Waste Treatment)

The addition of the new units would result in an additional maximum flow of up to 35,000 gpd effluent to the maximum observed volume of 27,000 from the existing treatment facility. This added discharge would require an increase in the permitted average discharge volume to 65,000 gpd. The characteristics of the effluent would not change. Flow would be varable due to rainfall because this discharge is primarily from floor and yard drains.

Outfall 003 Area Runoff Water (Coal Pile Rainfall Runoff)

The addition of Units 3 and 4 is not anticipated to affect TSS or pH, the present permit parameters for Coal Pile Rainfall Runoff. The lignite storage area is within the present coal pile loop. Thus, the total area drained and total waters collected should not change. Although, the type of coal would change, no problems are anticipated. This conclusion is based upon the low concentration of constituents such as trace metals and radionuclides observed in runoff from similar lignite from the San Miguel Power Plant site (Table 3-50).

Outfall 004-Regulates Stormwater Runoff From A Solid Waste Storage Area

The fly ash from Units 1, 2, 3 and 4 along with bottom ash, and scrubber sludge from Units 3 and 4 would be disposed of at an on-site semi-dry land fill operation. Units 1 and 2 bottom ash disposal would continue in the present ash pond and recirculating system. The proposed landfill disposal area would be developed in approximately 30-acre blocks. A total area of about 400 acres is planned for solid waste disposal.

As each thirty acre block is completed, it would be covered by a minimum of two feet of clay followed by 6 to 12 inches of topsoil to comply with Industrial Solid Waste Management Guidelines (TDWR, 1983). The area would be stabilized and reclaimed by seeding with common bermuda or other perennials to provide permanent cover. Cells closed in winter would be reclaimed using annuals such as rye grass to provide cover until the permanent grasses could be established.

TABLE 3-50
Radioactivity and Trace Element Concentrations
in the San Miguel Lignite Runoff Pond (TDH, 1983)

Trace Metal

Conc.(mg/L)

Se	Mo	As	Cu	Hg	Tl	Pb
0.036	-0.1	0.046	-0.02	-0.0002	-0.03	-0.05

"-" equals less than

Gamma Scan				Gross Alpha	Gross Beta
Ra-226	K-40	Total Ra	Total U	(pCi/L)	(pCi/L)
ND	ND	6.5±0.6	5.3±0.7	5.6±1.7	6.4±8.6

All undisturbed area runoff would be diverted away from the runoff collection pond to an unnamed tributary of Cedar Creek. Runoff from the 30-acre active disposal area would be collected in a pond designed to contain a 50-year storm event (9.8 inches in 24 hours). Runoff in excess of the 50-year storm event may overflow into the same unnamed tributary of Cedar Creek as the undisturbed area runoff. Water collected in the runoff pond would be pumped to the reclaim pond and utilized as makeup water to various plant systems.

Outfall 201-Regulates Low Volume Waste Discharges Into The Once Through Cooling Water Canal

Under the present NDPES permit for Units 1 and 2, all wastewaters, other than those discussed above (i.e., boiler blowdown, metal cleaning wastes, laboratory drains, de-mineralizer regeneration wastes, clarifier sludge, sanitary wastes, and process area drains) are routed to the ash pond recirculating system. Units 3 and 4 wastewaters, except for those discussed above, would be routed to the reclaim pond. These wastewaters would be utilized as makeup waters for plant operations such as fly ash wetting and solid waste disposal area dust suppression. The combined water balance for all Units 1, 2, 3, and 4 would result in complete consumption of the wastewaters under normal operating conditions. However, under certain operating (plant upset) and climatic conditions, there may be a reduced demand for these wastewaters for plant operations. When, or if such conditions occur, it is proposed that one or more of the following low volume wastewaters (in maximum amounts) would be discharged into the discharge canal (Outfall 101) with cooling water as required to maintain the proper water balance:

TABLE 3-50
Radioactivity and Trace Element Concentrations in the San Miguel Lignite Runoff Pond (TDH, 1983)

Trace Metal

Conc.(mg/L)

Se	Mo	As	Cu	Hg	Tl	Pb
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"-" equals less than

Gamma Scan				Gross Alpha	Gross Beta
Ra-226	K-40	Total Ra	Total U	(pCi/L)	(pCi/L)
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1. Boiler Blowdown, Units 1, 2, 3, and 4 - 25,000 GPD
2. Sewage Treatment Plant Effluent, Units 1, 2, 3, and 4 - 35,000 GPD
3. Regeneration Wastes, Units 1, 2, 3, and 4 - 75,000 GPD

Worst-case Impact from the Fayette Power Plant Site

In the water-quality evaluation, EPA considered a worst-case situation for plant operation with Units 3 and 4. This worst-case analysis (EPA, 1985) uses the same assumptions and methods as the worst-case analysis for the mine as well as the condition of a 24-hour, 100-year rainstorm event over the power plant occurring simultaneously with low-flow conditions in the site of impact, the Colorado River. The analysis also assumes Units 1 and 2 are operating at full capacity but that Units 3 and 4 are not, due to low electrical demand. With Units 3 and 4 operating only at stand-by capacity, wastewater would continue to be produced at reduced levels by such operations as personnel domestic wastewater, boiler cooling and blowdown water, de-mineralizer wastes and maintenance oily wastes. Normally this wastewater would be recirculated as make-up water for fly ash wetting, dust suppression and similar uses; however, during low-demand or rainy conditions, the wastewater would be discharged at the following maximum rates per source (Black & Veatch, 1984):

Source	Rate Per Source	Discharge Point
Boiler Blowdown	25,000 GPD	Reservoir
Demineralizer Regeneration	75,000 GPD	Reservoir
Domestic Wastewater	35,000 GPD	Reservoir
Non-Contact Cooling Water	48,000 GPD	Reservoir
Oily Waste Treatment Water	62,000 GPD	Cedar Creek
Total	245,000 GPD	

The total discharge, 245,000 gpd, is approximately 0.7 ac-ft. As a conservative assumption, a rounded value of 1.0 ac-ft was used in the analysis which exceeds the sum of the anticipated maximum discharges.

The quality of runoff from disturbed areas was set equal to the quality of the worst of the various sources. For wastewater effluent from existing and proposed NPDES discharges, source characteristics were taken from LCRA's NPDES permit application (Black & Veatch, 1984). For the fly ash and lignite runoff areas, LCRA sampling data for the existing fly ash pond and coal pile runoff pond were used.

As with the worst-case analysis for the mine, a twenty percent increment of pollution over existing conditions was used for an initial screening of potential pollutants for further analysis. Arsenic, cadmium, chromium, lead, mercury, molybdenum, selenium, sulfate and zinc were evaluated for the significance of their discharge - weighted runoff concentrations on the basis of the most restrictive water-quality standard or criteria for the Colorado River (See Table 3-51).

The power plant site does not have any exceptional sources of disturbed soil and no significant short-term impacts are expected due to the

TABLE 3-51
WORST CASE PROJECTIONS OF DISSOLVED QUALITY OF WATER REACHING THE COLORADO RIVER[1]

Parameters are those which exceed threshold ratio. All values in mg/l.
*Indicates values which reach or exceed criteria.

Constituent	Cedar Creek [2]	Most Restrictive EPA Water-Quality Criteria[3]
Arsenic	0.01	0.05
Cadmium	0.01*	0.000025
Chromium	0.02	0.05
Lead	0.01*	0.004
Mercury	0.002*	0.0002
Molybdenum	0.01	0.05
Selenium	0.01*	0.01
Sulfate	61	250
Zinc	0.01	0.08

1. EPA, 1985

2. Discharge-weighted concentration based on 5,339 AF having concentration of undisturbed runoff and 141 AF of disturbed runoff. Of the latter, 1 AF is assumed to have a quality equal to the highest indicated values for power plant wastewater (NPDES discharge point 001); 150 AF is power plant runoff, assumed to have highest indicated values for NPDES discharge point 002, oily waste treatment and storm drains; 67.5 AF is coal pile runoff, with quality as estimated in Brown (1979); and 22.5 AF is ash pile runoff, with quality as estimated in Griffin et al (1980).

3. Sources of criteria are EPA (1976), FWPCA (1968) and file data, EPA Region 6, Dallas, Texas.

worst-case flood. Therefore, a worst-case analysis of sediment borne pollutants was not performed.

Table 3-51 shows concentrations of cadmium, lead, mercury and selenium to reach or exceed criteria. The criteria used for cadmium, 0.000025 mg/l, is based on sensitive crustacean species. This criteria is far below the detection limit for measuring water-borne cadmium. For this reason, it is not possible to say whether or not existing Cedar Creek water, or water in the Colorado River, exceeds the criteria. The projection that cadmium in worst-case runoff would exceed the criteria is, thus, of uncertain significance. That is, there is no basis for knowing if the worst-case runoff would really have a significant impact compared to existing conditions.

Nonetheless, it is clear that power plant runoff is likely to be enriched in cadmium, compared to undisturbed runoff. It may be appropriate for LCRA to monitor cadmium levels in the various water sources, including storm runoff from the plant, NPDES discharges, and the coal pile and ash pile runoff, as well as background levels in Cedar Creek and and Colorado River. If, in fact, the net cadmium content of plant-related sources is significantly higher than background levels (i.e. the 5.6 threshold will be exceeded), then treatment to reduce cadmium concentrations in the most potent source may be appropriate in terms of its cost-effectiveness as an environmental mitigation measure.

The analysis for lead and mercury is somewhat similar, except that the available data indicate that undisturbed streamflow does exceed the criteria and the effect of the worst-case storm is to increase those concentrations by a relatively small amount, but not to create a unique problem. Indeed, lead levels would be unlikely to pose a hazard due to the ease with which this metal sorbs on sediment. For mercury, the projected potential problem relates almost entirely to the relatively high concentration in oily wastes (NPDES discharge point 002), which were assumed to reflect the net concentration in all power plant runoff. However, the actual discharge of oily waste is less than 1 percent of the projected runoff and the average concentration of the metal is expected to be 0.0003 mg/l. Thus it is likely that the actual mercury concentration of the worst-case storm would be relatively close to the criteria of 0.0002 mg/l. However, this analysis does not completely eliminate the possibility of toxic shocks caused by the worst-case runoff from the power plant area. Thus, the monitoring and treatment discussion presented for cadmium may also apply to lead and mercury.

For selenium, the criteria given in Table 3-51 is for drinking water and reflects chronic or persistant concentrations. EPA's recommended limit for the 24-hour selenium concentration to protect sensitive aquatic species is 0.035 mg/l. This is less than the predicted value given in Table 3-51. Nonetheless, for reasons described more fully in the discussion of biological resources, monitoring for selenium levels may be appropriate.

Thermal Impacts

LCRA performed a computer program analysis to predict the heat transfer to the reservoir from all 4 units and estimate the condenser circulating water inlet temperatures. The computer program was developed and verified by comparing its predicted temperatures to actual temperatures obtained from station datalogs for Units 1 and 2. The station equipment coolers are designed for an inlet water temperature of 95°F. The existing baffle dike arrangement should be capable of providing the required cooling capability for Units 1, 2, and 3 under most extreme ambient and operating conditions. However, with four units operating at valves-wide-open, 5 percent overpressure, the peak average daily condenser inlet water temperature was estimated to be 97.5°F. Although most station equipment coolers will perform satisfactorily with slightly increased temperatures, LCRA has evaluated baffle dike extensions to increase the effective surface area of the reservoir and a submerged pipe intake. Also the construction of an additional reservoir is possible in the Baylor Creek watershed. No decision has [illegible]n made on the alternatives to reduce the increased thermal load.

Historic temperature and thermocline depth information were not available for the Fayette County Reservoir. Therefore, thermal effects could not be predicted on the lake by modelling. The maximum surface temperature observed in 1983 (See Table 3-35) for a central lake profile was 95°F with a corresponding bottom temperature of 64.4°F for August. Intake and discharge temperatures are anticipated to be distributed as shown in Table 3-52.

TABLE 3-52

INTAKE AND DISCHARGE TEMPERATURE FREQUENCIES OF OCCURRANCE

Percentile

	10%	5%	1%	Maximum (°F)
Intake	93.4	94.5	95.3	97.6
Discharge	115.0	116.7	118.0	118.4

The prevailing wind direction during the summer is from the south-south east. This wind direction helps to keep the heated water from reaching the eastern, southeastern and southern portions of the reservoir. Ecological data has been collected on reservoirs used for power plant cooling for many years. Sharp and Grubb (Radian, 1973) examined existing data on fish productivity in reservoirs receiving preheated effluent from power plants and those receiving none, and found no significant detrimental effects attributable to heat. A statistical analysis of Texas Parks and Wildlife Department fish data from 15 reservoirs showed fish production to be as good, if not better, in heated reservoirs as compared to non-heated reservoirs. Fish have been observed in the discharge canal of Fayette County Reservoir where temperatures reached around 100°F (Bounds, 1984). However, availability of shallow water refuges at temperatures conducive to spawning for bottom-spawning species such as largemouth bass and channel catfish is a major concern. According to Coutant (1975), largemouth bass spawning occurs at temperatures of 59.9 - 77.9°F; successful spawning seldom occurs above 89.6°F. Channel catfish spawning occurs at temperatures ranging from 59.8-84.2°F with an optimium of 80.6°F (Clemens and Sneed, 1957). The mid-depth temperature observed for May, 74.7°F, indicates that a 5°F rise could adversely impact spawning of these managed species of interest.

In conclusion, increased temperatures in Cedar Creek reservoir from Units 3 and 4 effluent constitutes seasonal adverse or beneficial impacts.

Outfall 001-Reservoir Blowdown

The discharge from the reservoir to Cedar Creek at outlet 001 is limited to 95°F (35°C) maximum for temperature. This limitation is based upon Segment 1402 water quality standards (TDWR, 1981) set to protect the beneficial uses of the stream including fish and wildlife propagation. Compliance data for 1983 shows a maximum temperature of 73.4°F for this outfall in August. It is not anticipated that the increased thermal effluent to the reservoir (maximum of 5°F) would approach this limit.

Additional Units 3 and 4 are not expected to affect the rate of discharge within the first five years of operation; however, the dissolved solids concentrations will increase faster with new units. Although it is not anticipated, a future increase in reservoir blowdown quantity may be necessary to maintain reservoir water quality below 900 mg/l total dissolved solids.

3.5.2 Groundwater

Existing Conditions

Table 3-61 (see Section 3.6) summarizes the water-bearing characteristics of the geologic units of the area. Usable groundwater in the proposed project area is principally contained in the Oakville Sandstone, the Catahoula Formation, the Jackson Group (the Whittsett and Manning Formations), and the Yegua Formation. All of these units have been reported to yield at least 50 gallons per minute of fresh to moderately saline groundwater to pumping wells (Rogers, 1976; Jackson and Garner, 1982). Some groundwater is also contained in stream channel deposits.

The principal aquifers are layers of fine sand separated by thin clays and silty clays of low permeability. On the scale of the proposed actions, the sand horizons behave as relatively independent units; this is shown 43 by pumping tests in the proposed mine area, each consisting of one pumping well and up to three observation wells completed into zones separate from that being pumped (LCRA, 1984a). Regionally, however, some hydraulic interconnection probably exists between sand zones since they are not separated by thick sections of relatively impermeable strata.

Recharge of the sand units occurs primarily on the outcrop, from direct precipitation and seepage of stream flows. Areas of regional recharge may extend over hundreds of square miles. Water in the saturated material tends to move down dip, with local variations in direction controlled by lithology and topography. Rates of flow would be expected to be highly variable, ranging from a few tens of feet per year through sands, to a few inches per year or less in the clays (Fogg et al., 1983). Groundwater discharge from the units occurs mostly by upward leakage into overlying, less permeable strata and, ultimately, to the surface in the forms of seeps, springs or river baseflow. Small amounts of water are pumped from wells for domestic and stock purposes. Generally, water in the outcrop belt is under water-table conditions, but downdip the effects of confinement by the less permeable strata above and below the aquifer produce artesian conditions.

Mine Site. In the mining area, only the Jackson Group and the Yegua Formations were found to contain groundwater (LCRA, 1984d). The Catahoula Formation is saturated east (downdip) of the mine site, but locally its principal hydrologic function is to transmit some recharge from precipitation downward. Measurements at the mine area indicate that water levels in wells range from 60 to 130 feet below ground surface. No groundwater was encountered above the 8500 lignite horizon. Local flow is generally east to northeasterly (LCRA, 1984d), along the trend (strike) of the major sand units which locally cut across the regional dip.

Aquifer properties were determined for 4 sand units at 12 locations within the proposed mine area (LCRA, 1984a). Results indicate low to moderate transmissivities, ranging from 253 to 1740 feet^2/day. The calculated hydraulic conductivities (permeabilities) are relatively uniform, ranging from 8 to 25 feet/day. Storage coefficients range from 0.02 to 1×10^{-5}. Generally, groundwater above the 6500 lignite horizon was found to occur under unconfined (water table) conditions, while groundwater below this horizon was found to occur under confined (artesian) conditions.

A well survey conducted by LCRA identified 143 domestic and stock wells in and about the proposed 10-year permit boundary; 41 are located within a one-mile perimeter outside the boundary (LCRA, 1984a). About two-thirds of the wells are less than 350 feet deep; about one-third are less than 200 feet deep. The existing wells primarily tap the Jackson Group with a few located in the Yegua and Catahoula Formations. No municipal supply wells are located within nine miles of the proposed 37-year mine boundary.

Baseline groundwater quality data for the Jackson Group sands at the proposed mine area are presented in Table 3-53. In general, pH averages about 6.0, and average total dissolved solids (TDS) concentrations range from 300 to 700 milligrams per liter (ppm). The TDS levels are relatively low for the region and indicate that the wells are situated close to recharge zones. Concentrations of many dissolved trace elements species increase with increasing acidity (decreasing pH). Of the trace elements with low enough detection limits, concentrations of dissolved iron and manganese usually exceed recommended drinking water standards.

The Yegua Formation underlies the Jackson Group throughout the proposed mine area. Yields from the unit are reported to range from low to high in Fayette County (Rogers, 1976). The formation represents the most viable alternative water bearing unit should wells in Jackson Group need to be replaced. The Yegua is considered a minor aquifer and is known

TABLE 3-53

QUALITY OF GROUNDWATER IN THE PROPOSED MINE AREA

JACKSON GROUP SANDS

Values are means of data collected in 1980-83,
for sands in the given horizon intervals.
Data reflect dissolved concentration, in mg/l, unless noted.

Parameters	7500-6500	6500-5500	3500-2500	2500-1500	Federal Drinking Water Standards Guidelines
pH (standard Units)	7.0	5.25	5.7	6.1	6.0 - 8.5*
Arsenic	0.13	0.015	0.09	0.09	0.05
Calcium	51	68	28	19	
Magnesium	5.95	13.2	4.24	2.86	
Sodium	91.8	95.9	14.1	61.9	
Potassium	23	10	7.0	5.6	
Bicarbonate	62	179	22	55	
Sulfate	82	191	67	62	
Chloride	49	161	70	52	
Fluoride	0.34	1.01	0.29	0.27	1.4 - 2.4
Nitrate (as N)	lt 0.01	0.01	0.16	0.16	10.0
Total Dissolved Solids	525	697	408	306	
Aluminum	lt 0.08	0.79	0.04	0.17	
Cadmium	lt 0.01	0.020	0.03	0.05	0.01
Copper	0.01	0.023	0.03	0.04	
Iron	0.22	5.79	1.62	0.56	0.3*
Lead	lt 0.10	0.012	0.03	0.08	0.05
Manganese	0.15	0.434	0.13	0.11	0.002
Mercury	0.05	0.005	0.008	0.04	
Molybdenum	0.06	0.03	0.01	0.03	
Nickel	lt 0.02	0.08	0.04	0.05	
Selenium	lt 0.015	0.003	0.247	0.10	0.01
Zinc	lt 0.01	0.257	0.077	0.06	
Chromium	0.04	0.03	0.06	0.03	0.05

Source: LCRA (1984d); EPA (1976a)

*Suggested maximum concentration of range
lt=less than

to yield some potable water. Regionally the formation is tapped by several municipal wells and is used for irrigation. Water from Yegua sediments mainly serves rural, domestic and livestock purposes. The formation produces small to moderate amounts [less than 500 gallons/minutes of fresh to moderately saline water (from less than 1,000 to 10,000 ppm dissolved solids)], but the quality is highly variable.

Conveyor and Power Plant. Data on water-bearing units along the conveyor corridor or at the Fayette Power Plant are minimal. Soils-boring records at the plant site indicate that the first saturated sand horizon is found about 70 feet below ground surface, and is overlain by a thick clay sequence. Available transmissivity and hydraulic conductivity data for the Catahoula Formation and the Oakville Sandstone (Rogers, 1976) are of the same magnitude as those described for the Jackson Group sands at the proposed mine area.

Mine Construction and Operation

Construction of mine facilities will result in some disturbance of surface and shallow subsurface material over a relatively small area, but should not result in impacts to the groundwater system. Mine operations will have more significant effects including: interruption or loss of private water supply wells; groundwater depletion and resaturation of local sediments; and changes in groundwater quality. In general these impacts are either short-term (lasting one year or less in any given location), and not especially different for individual years; or they are cumulative, hence reaching a maximum at the end of the mine life. Because mining would take place in the Jackson Group, the following analysis will focus on effects of mining on aquifers in the Jackson.

The most direct impact of the proposed mining operation is that about 30 water wells in the mining area will be abandoned or removed during mining or construction activities. LCRA will comply with Section 351 of the Texas Railroad Commission (RRC) regulations, which requires that water supplies be replaced if affected by contamination, diminution, or interruption resulting from the surface mining (LCRA, 1984d). Additional impacts to surrounding wells will result from the local lowering of the water table which results from groundwater withdrawals caused by dewatering and depressurization. Dewatering refers to the pumping of groundwater that seeps into the mine from the strata being mined and from the overburden above the lignite. Depressurization refers to the pumping of groundwater from aquifers underlying the deepest lignite horizon in order to reduce groundwater pressure, and thus eliminate risks of heaving of the pit floor. Once the excavated overburden is replaced onto the pit area, neither dewatering nor depressurization are required at that location.

The quantitative aspects of dewatering and depressurization have been preliminary defined by LCRA in studies performed to date; these effects will depend upon the groundwater conditions encountered and control methods employed at any given time at the mine. Independent of LCRA's analyses, impacts on groundwater have been partially quantified for this EIS using simple models, reasonable worst-case assumptions and the best available regional and site-specific data.

The dewatering requirements from groundwater seepage into the mine have been estimated by LCRA to range from a few hundred to 2.0×10^6 gallons per day (gpd). During the first three years of mining pit seepage is expected to be negligible, increasing significantly in Mining Year 4 and gradually increasing to 1.9×10^6 gpd during Mining Year 10. These values generally correspond with those calculated for this EIS; average annual seepage rates for Mining Years 9 and 10 were estimated to be 5.4×10^5 gpd. LCRA projections indicate that the yearly totals will fluctuate as the pits advance to the north with maximum peaks occurring in Year 15, 23 and 26.

The seepage will lower water levels and decrease well yields within the area of influence created by the operation. The impact has not been quantified by LCRA, but appears to be as follows:

> The largest decline in water levels would occur immediately adjacent to the highwall.
>
> A first-order steady-state calculation indicates that at a maximum mining depth of 350 feet, the maximum horizontal distance over which drainage of the aquifer will occur will be less than 2500 feet. Given the discontinuous and heterogeneous nature of the sand zones, this estimate may be high by a factor of two or more.
>
> At the 2,500 foot distance, drawdowns could be as much as 20 feet by the end of the 37-year mining period, assuming extensive vertical communication among aquifers. Less drawdown would occur at greater distances from the highwall.

To facilitate mining the 2500 lignite horizon, localized depressurization of the 2500-1500 sand units is proposed by LCRA. Pumping rates will vary depending upon the hydrostatic pressure relief needed at a particular location. The estimated maximum pressure relief required is 240 feet, and the estimated average pressure relief required is 150 feet. Lower pressure reductions would be satisfactory where the 2500-1500 sand unit is less thick.

Eight well fields, each consisting of from three to six wells pumping at rates of 25 to 60 gallons per minute, were designed by LCRA for the pressure relief. Groups of wells were scheduled to be put into operation during Mining Years 4, 7, 9, 13, 17, 22, 28 and 34. The volume of water from depressurization is estimated by LCRA to range from 1.9×10^5 gpd to 3.9×10^5 gpd.

Projections of depressurization pumpage and associated water level declines were made for this EIS. Impacts were assessed for the condition when maximum pressure relief is required and for the condition when average pressure relief is required.

Table 3-54 presents the calculated theoretical water level declines at selected distances from the pressure relief wells. The analysis assumed a linear network of six fully penetrating wells parallel to the excavation. The worst-case and average pumping rates are 1250 and 780 gallons per minute, respectively, assuming a high estimate of aquifer thickness (20 feet) and transmissivity (400 feet^2/day) and assuming very deep excavations (Charbenau and Wright, 1982). Estimates of associated water level declines have been made using Theis (1935) nonequilibrium equations.

Duration of pumping was assumed to be one year, corresponding to the proposed mining schedule. The declines shown in Table 3-54 would apply only to tightly-cased wells tapping the same sand in which the pumping wells are completed.

TABLE 3-54
THEORETICAL DISTANCE OF DRAWDOWN IN SURROUNDING WELLS
DUE TO MINE DEPRESSURIZATION

Distance In Feet From Center of Excavation	Drawdown In Feet After One Year of Pumping	
	Worst-Case Pumpage	Average Pumpage
500	243	152
2,000	215	134
5,000	163	102
10,000	110	69

Source: Gallaher, 1985.

While the theoretical idealized effects of depressurization shown in Table 3-54 are potentially widespread and sizeable, it is unlikely they will occur in nature. Geological and hydrological discontinuities in the sand unit will significantly moderate the effects of depressurization from those calculated. Results of the LCRA pumping tests of the 2500-1500 sands support this: geological variabilities precluded the effects of depressurization of one sand body from being significant in adjacent sand bodies located less than one thousand feet away.

Water levels in wells located within two to three miles of the proposed mine may temporarily decline, thereby potentially increasing pumping costs for groundwater users. The most significant water level decline would be within one mile of the mine excavation; the communities of Nechanitz, Waldeck, and Ledbetter are the most likely to be affected. Nechanitz and Waldeck would potentially be the most affected during the 10-year permit period, and Ledbetter during the latter phases of the 37 year mining period. Adverse impacts to the productivity of groundwater wells in the affected one-mile zone may be long-term in nature if the depressurized sand bodies are not hydrologically connected to a major recharge zone. In such cases, the provisions of the RRC regulations, which call for the replacement of disrupted water supplies, would apply.

Aquifer Recharge. Once mining has been completed at any location, the newly placed soil will be resaturated by: 1) infiltration of precipitation; 2) upward leakage from sand bodies beneath the mine; 3) inflow from sand bodies adjacent to the mine; and 4) seepage of water through the end lake bottom and sides. In effect, the water displaced by the mining operation will be replaced by natural groundwater, flowing in an environment modified from the present.

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Post-mining recharge rates from precipitation should be slightly increased over present rates due to breaking up of clay strata and overall increase in porosity, resulting in increased vertical permeability.

However, there may be some decrease in horizontal permeability due to the mixing of clays with the existing sandy zones. This would lead to a slight decline in the ability of the spoil to transmit water to sandier zones adjoining the mine pit. Recharge from below the mine is expected to be minimal, due to the fact that the mine is underlain by a thick clay unit.

The time necessary for resaturation to occur due only to infiltration of precipitation, is estimated to range from a worst case time of 64 years (if recharge is 3 inches per year) to a more probable time of 23 years (based on recharge of 8 inches per year). These estimates assume a porosity of 20 percent and an average desaturated overburden thickness of 80 feet.

Recharge from adjacent sand bodies is expected to be significant only around the mine pit perimeter. The horizontal velocity of groundwater moving through the reclaimed spoil is estimated to be on the order of 10 feet per year; therefore, it potentially would take about 50 years for groundwater to move across only one-eighth of the pit width.

Resaturation will be greatly enhanced by seepage from the end lake. The USBM (1982) evaluated conditions in mines with similar stratigraphy to Cummins Creek; considering all sources of recharge, including seepage from a deep large pond, they estimated that resaturation should be completed within 5 to 10 years.

Aquifer productivity in the reclaimed spoil areas is expected to be diminished in terms of maximum possible yield, due to the decrease in the horizontal permeability of the overburden material. The use of significantly greater screened intervals for wells placed in the resaturated overburden, however, may produce well yields close to pre-mining conditions. The amount of decrease in maximum yield will also depend upon the interrelationship of altered groundwater levels and changes in aquifer storage characteristics.

Impacts on Groundwater Quality. Post-mining impacts on groundwater quality are a function of the quality of the water resaturating the spoil, the rate of recharge, and the type, distribution, and leachability of the spoil materials. Water percolating through the spoil would be subject to some degradation in quality, with the degree of change being variable and difficult to quantify without detailed laboratory soil-column leaching experiments for all contaminants of concern. Evaluations discussed below indicate that significant impacts are not expected due to: relatively minor changes in quality at the mine site; the long time required for transport of contaminants from the mine; and attenuation of any contamination during transport.

Literature sources indicate that, as a result of lowering the water table through dewatering, and physical alteration of the overburden materials, certain minerals are susceptible to chemical alteration (oxidation) and increased solubility (Hounslow et al., 1978; EPA, 1979a). The most significant changes in water quality observed on other Texas lignite mines are increases in the concentrations of sulfate, chloride and total dissolved solids (French, 1979; Lentz, 1975). Increased sulfate levels (hence also TDS) are especially likely. This constituent poses no significant health problem; however, water high in sulfate concentration can act as a laxative to people not accustomed to it. Unless the pH decreases to less than 4.0 (see subsequent discussion), average total dissolved solids in the resaturated spoil are not expected to exceed 1500 milligrams per liter, a level two to five times over pre-mining levels (See Table 3-53). This is based on analyses of laboratory saturated paste extracts of overburden cores (Table 3-55).

Trace element and radionuclide concentrations in overburden materials are within the range typically found in rocks and soils throughout the U.S. (Table 3-55). Mobilization of these constituents to potentially toxic levels would be expected only if the pH of the water resaturating the overburden is lowered to 4.0 or less.

Clearly, the prognosis of relatively limited impacts is dependant on pH not decreasing to less than 4.0. Actual changes in pH would result from acid produced by oxidation of pyrite (iron disulfide). Overburden geochemical analyses (Table 3-55) indicate that zones below the 5500 lignite horizon contain sufficient amounts of pyrite to cause undesirable acidity. LCRA proposes to keep, by mining and materials handling, potentially acidic materials in the lower half of the overburden mix so that the material is more likely to be saturated, hence less likely to be oxidized. With dewatering and depressurizing, however, even the deep spoil may be oxidized at times. As acid production can occur within a period of a few days to a few years in an oxidizing environment (Stumm and Morgan, 1981) it is possible that acid conditions could develop on a local basis.

To predict possible pH changes resulting from the mining process, a series of computer simulations was performed for this EIS using the program PHREEQE; the program is described by Parkhurst et al. (1980) PHREEQE allows for simultaneous solution of the dominant chemical reactions that are believed to influence water quality in the spoil. The reactions simulated for the study area were: 1) dissolution of pyrite by rain water within the oxygenated unsaturated spoil; and 2) reaction of the product water with minerals which are known to be present in some U.S. coal overburdens and which impact acid drainage problems. The minerals are calcite - which will buffer acidic water - and goethite, which can control iron concentrations (Seifert, 1984). Both sets of reactions were simulated under widely varying degrees of oxygenation, thus ensuring calculation of worst case conditions; the results are detailed (Longmire, 1985).

Results of the analysis indicate that during resaturation, highly acidic water (pH of 2 or less) could develop locally in the spoil. However, such a low pH would exist only temporarily. Upon resaturation, reducing conditions would be reestablished; elimination of free oxygen would greatly reduce further weathering of pyrite. The results indicate that even in the absence of calcite or goethite to buffer the acid water, pH levels are calculated to recover to premining levels (pH = 5.5). Constituents which might be dissolved in the local, highly acidic

TABLE 3-55

CHEMISTRY OF MINE OVERBURDEN AND BACKGROUND SEDIMENTS

All Concentration in parts per million (ppm) unless noted

Parameters [3]	OVERBURDEN [1]		BACKGROUND [2]	
	Above 5500 Ligite	Below 5500 Lignite	Sandstone	Shale
Arsenic	0.3 - 20	0.8 - 16	1 - 4	6 - 9
Boron	0.01 - 2	0.01 - 13	18 - 63	21 - 41
Cadmium	0.05 - 1.2	0.2 - 1.0	no data	0.3
Chromium	1 - 68	2 - 101	2 - 39	62 - 130
Copper	1 - 43	2 - 29	1 - 8	13 - 130
Iron	0.2 - 509	0.8 - 782	900 - 19000	18000 - 45000
Lead	1 - 49	4 - 41	5 - 17	11 - 24
Manganese	10 - 671	36 - 420	29 - 300	65 - 420
Molybdenum	1 - 11	1 - 8	0.2	2
Selenium	0.01 - 1.5	0.01 -55	0.01 - 0.1	0.5 - 0.6
Uranium [4]	04 - 32.1	05 - 4.7	0.45	3.2
Zinc	6 - 102	15 - 173	5 - 31	55 - 82
pH (standard Units)	3.0 - 7.2	2.8 - 7.8		
Conductance (mmhos/cm) [5]	0.01 - 5.4	0.6 - 6.9		
Pyritic sulfur (%)	0.01 - 1.5	0.01- 2.1		
Acid potential [6]	0 - 50	0 - 152		

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1. LCRA, 1984a.
2. Conner and Shacklette, 1975.
3. Parameters selected to reflect potential overburden chemistry which mihgt be unusual.
4. For the above 5500 lignite horizon, higher concentrations are suggested by geiger counter readings in exploration drill holes; see Section 5.2.2. Overall average concentration is 1.8 ppm.
5. Analyses of saturated overburden pastes.
6. Tons calcite per 1000 tons soil.

oxidizing environment would reprecipitate or be adsorbed as reducing conditions are restored and the pH increases. The resultant trace element and radionuclide concentrations in the spoil groundwater are anticipated to be similar to those of pre-mining conditions.

Once the water table is re-established, any leachate would have the potential to flow in a plume from the proposed mine to adjacent, downgradient groundwater bodies (i.e., to the northeast). Typically, the first such discharge would have the poorest quality, with subsequent leachate having lower concentrations of potential pollutants. Based on aquifer properties discussed previously, the rate of movement of a contaminant plume would be very slow, with about 100 years being required to transport leachate 3000 feet from the mine boundary. This means that almost all the contaminants would still be within the proposed mine boundaries; thus, time is sufficient to permit effective monitoring and mitigation in the event the leachate plume is of unacceptable quality.

Contaminant concentrations in any plume would be reduced with distance from the mine area due to factors such as mechanical dispersion, adsorption and cation exchange, and dilution by downward leakage of groundwater in overlying formations. One-dimensional calculations performed for this EIS indicate that dispersion and dilution should reduce the peak contaminant concentrations downgradient of the proposed spoil area. At a distance of approximately three and one-half miles downgradiant, the peak concentration would be about 25 to 40 percent of that in the spoil water. Chemical processes would serve to further reduce the contaminant concentrations, particularly those of heavy metals such as iron which are likely to adsorb on fine-textured sediments. The concentration of uranium is similarily projected to be quite low due to the pressure of pyrite, hydrogen sulfide, ferrous iron and organic matter as reducing agents.

In summary, long-term problems with trace element contamination of groundwater are not expected. If significant degradation of groundwater quality does occur, it would be restricted to the proposed mine spoil area for at least one century, and ultimately to an area within a three and one-half mile wide zone east of the proposed mine area.

The analysis indicates that it is both necessary and relatively easy for LCRA to implement its plans to install monitoring wells and evaluate spatial and temporal changes in the quality of water in the resaturating spoil (LCRA, 1984d; see subsequent discussion).

Replacement of affected water supplies and/or aquifer restoration may be needed if the geochemical reactions do not occur as predicted. The aquifer units below the mineable zone exist under confined conditions, and are protected by a thick, impermeable clay stratum so that adverse impacts from mining are not expected. If natural water-quality allows, supply wells could be installed into these units upon completion of reclamation activities to replace the loss of shallow wells as a result of mining activities.

Groundwater Protection Plan. To monitor water level and water quality effects of mining, clusters of wells finished in the four main sand units would be tested by LCRA during the active life of the mine as well as following reclamation. Wells presently located in the path of the proposed mine would be monitored until destroyed by the mining process. Upon reclamation, wells would be drilled and constructed to determine the water quality and hydraulic characteristics of the reclaimed material. In addition, shallow piezometers would be installed on the permanent overburden stockpile to determine changes in groundwater quality resulting from infiltration of runoff on the stockpile. Operational monitoring is proposed to include water level, pH, total dissolved solids, total iron, total manganese, sulfate and chloride.

A review of the proposed monitoring plan indicates that it is generally satisfactory for groundwater protection. However, certain of the following monitoring plan modifications may be appropriate:

1. Baseline radionuclide concentrations should be determined for existing monitoring wells located within the proposed mine boundary. At a minimum, three separate sets of samples should be collected and analyzed for dissolved gross alpha and beta particle activities, and for dissolved natural uranium concentration. In-situ measurements of dissolved oxygen concentrations and/or oxidation-reduction potentials also are recommended.

2. Baseline chemical concentrations in the Yegua Formation should be better defined. It has not been adequately demonstrated that the Yegua is chemically suitable for use as a possible alternative water supply.

3. In the operational monitoring program, dissolved concentration of iron and manganese should be determined rather than total concentrations.

4. After reclamation, the operational monitoring program should be expanded to include the trace elements tested for in premining conditions, as well as for the radiochemical parameters detailed in (1) above. Dissolved oxygen concentrations and/or oxidation-reduction potentials should be routinely performed on wells drilled into reclamed spoil, particularly during the resaturation phase.

Overland Conveyor Construction and Operation. Construction activities associated with the conveyor corridor would only affect near-surface geological features. No adverse impacts on ground water are expected from this phase of the proposed action. The operation of the conveyor would be above ground so that a short-term spill of lignite would be the worst-case of potential pollution of the ground water. Due to the low probability and magnitude of the potential impact, a worst-case analysis was not done on this part of the proposed project.

FPP Units 3 and 4 Construction and Operation. Minimal changes in groundwater resources would be brought about by construction of the power plant facilities. Slight reduction in infiltration rates in the vicinity of construction activities may occur. No regional impacts to the groundwater system would occur because of the relatively small area affected.

Impacts associated with operation of proposed Units 3 and 4 are principally limited to the proposed new fly ash disposal area. The fly ash from Units 1, 2, 3, and 4 along with bottom ash and scrubber sludge from Units 3 and 4, would be disposed of at an on-site semi-dry landfill operation. Units 1 and 2 bottom ash disposal would continue in the present ash pond and recirculating system.

The proposed landfill would be developed in approximately 30-acre blocks, to a total of about 400 acres. As each block is completed it would be covered by a minimum of two feet of clay followed by 6 to 12 inches of topsoil to comply with Industrial Solid Waste Management Regulations (TDWR, 1983). The area would be stabilized and reclaimed by seeding. All natural runoff to the landfill site would be diverted to an unnamed tributary of Cedar Creek.

Seepage from the landfill is expected to be minimal because of two factors. First, water will not be allowed to pool in the landfill area; it will be collected in a retention pond constructed for that purpose, and then pumped to the reclaim pond which is part of the existing operation. Second, on-site soil borings data indicate that the landfill is underlain by an average of approximately 22 feet of unsaturated clay. This material represents a major barrier to infiltration of seepage water.

At projected permeabilities and hydraulic gradients it would take several hundred years for the seepage to reach groundwater, underlying the site at a depth of 73 feet. During this time, natural attenuation processes such as ion exchange, adsorption, and diffusion would dramatically reduce peak concentrations (Radian, 1975). For example, less than one foot of clayey soil would be expected to remove over 95 percent of the cadmium from pit leakage after 20 years of continous flow. Significant degradation of groundwater is not likely. Moreover, the slow rate of transport provides adequate opportunity for effective monitoring and mitigation in the event impact occurs.

3.6 EARTH RESOURCES

3.6.1 Topography

Existing Conditions

The Cummins Creek Project is located in the Gulf Coast Physiographic Province. The area is characterized by gently undulating hills with occasional gullies and rapid erosional features. Figures 3-20 and 3-21 present the major topographic characteristics of the area. The figures show those areas within the mine study area and conveyor study area.

The FPP site is located on a topographic ridge that is bounded by Cedar Creek to the east and Baylor Creek to the west. Elevations range from 265 feet above sea level in the southwest corner of the site to over 425 feet in the northern areas of the site. Power plant Units 1 and 2 are already in operation on the site. General site preparation for construction of Units 3 and 4 was completed during the construction of Units 1 and 2.

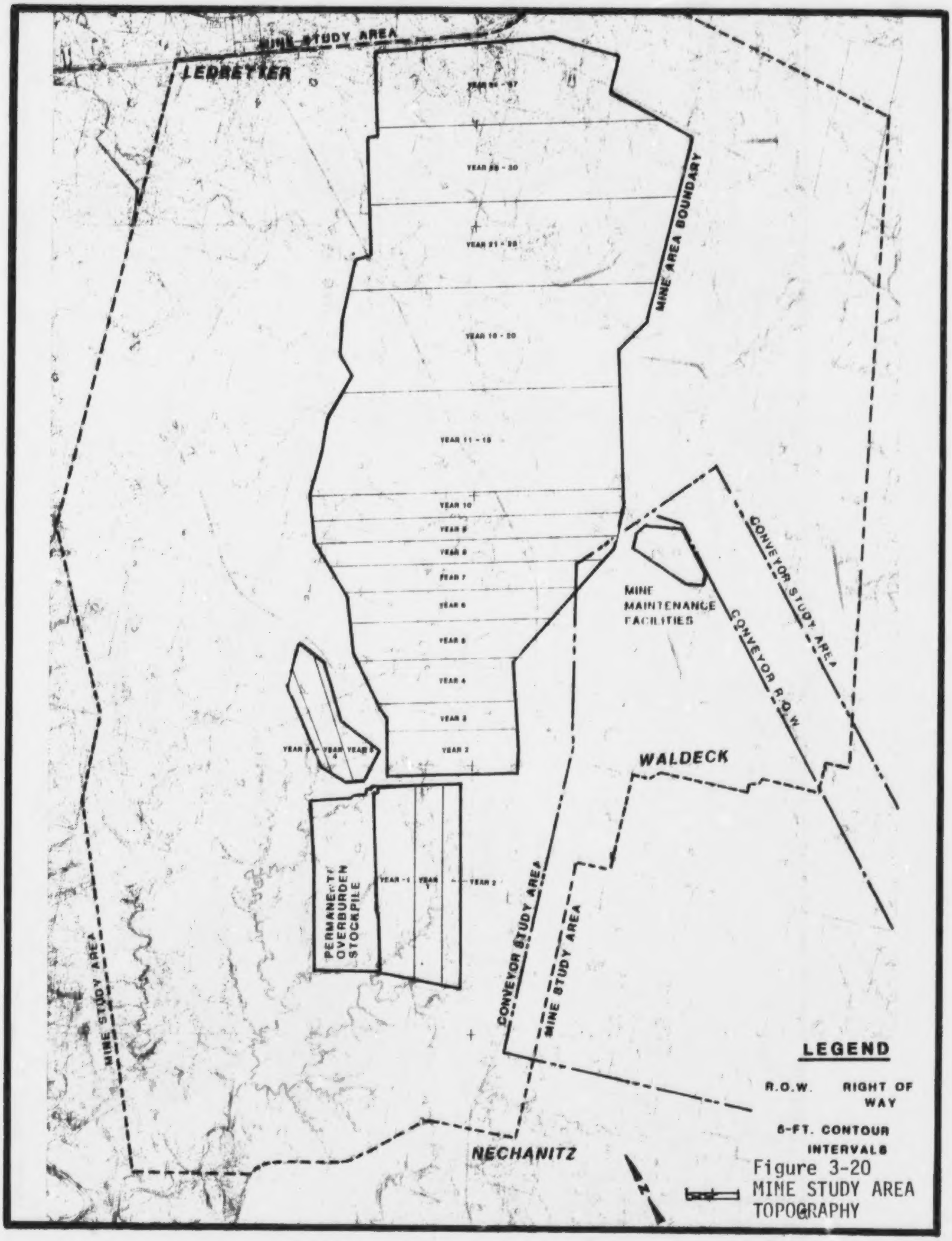
MINE STUDY AREA
LEDBETTER
YEAR 31 - 37
YEAR 26 - 30
YEAR 21 - 25
YEAR 16 - 20
YEAR 11 - 15
YEAR 10
YEAR 9
YEAR 8
YEAR 7
YEAR 6
YEAR 5
YEAR 4
YEAR 3
YEAR 2
YEAR 3
YEAR 4
YEAR 5
MINE AREA BOUNDARY
MINE MAINTENANCE FACILITIES
CONVEYOR STUDY AREA
CONVEYOR R.O.W.
WALDECK
PERMANENT OVERBURDEN STOCKPILE
YEAR -1
YEAR 1
YEAR 2
CONVEYOR STUDY AREA
MINE STUDY AREA
MINE STUDY AREA
NECHANITZ
LEGEND
R.O.W. RIGHT OF WAY
5-FT. CONTOUR INTERVALS
N

Figure 3-20
MINE STUDY AREA
TOPOGRAPHY

Reproduced from
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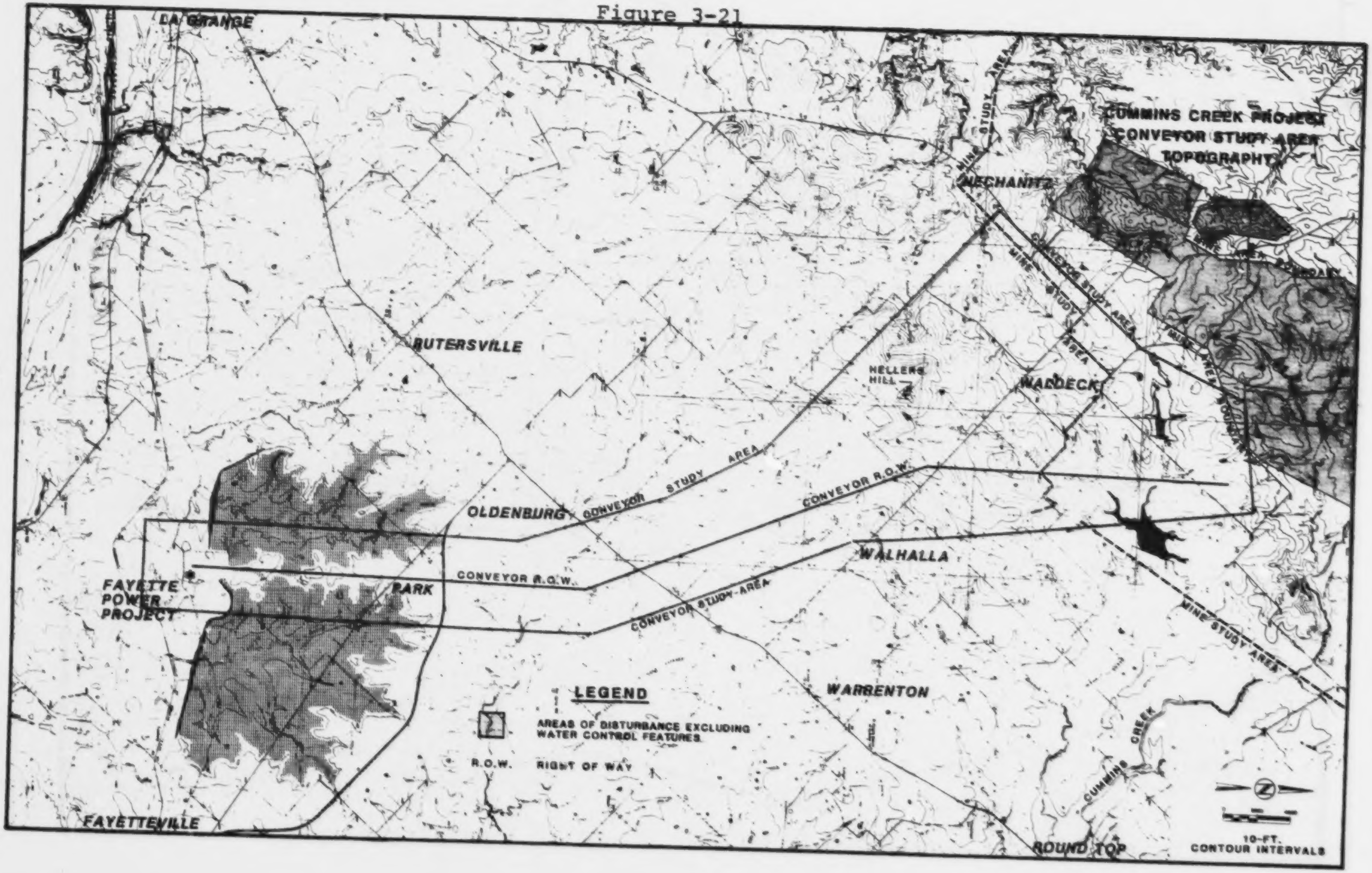
Figure 3-21


CUMMINS CREEK PROJECT
CONVEYOR STUDY AREA
TOPOGRAPHY
LA GRANGE
RUTERSVILLE
MECHANITZ
HELLERS HILL
WALDECK
OLDENBURG
PARK
FAYETTE POWER PROJECT
WALHALLA
WARRENTON
FAYETTEVILLE
ROUND TOP
CUMMINS CREEK
MINE STUDY AREA
CONVEYOR STUDY AREA
CONVEYOR R.O.W.
MINE AREA BOUNDARY
LEGEND
AREAS OF DISTURBANCE EXCLUDING WATER CONTROL FEATURES
R.O.W. RIGHT OF WAY
10-FT. CONTOUR INTERVALS

The majority of the mine study area is within the Cummins Creek watershed. The south and southwestern extremities of the mine study area are within the Rabbs Creek watershed. Four tributaries flow into Cummins Creek: Turkey Creek, Pin Oak Creek, Alexander Creek and Mile Branch Creek. Owl Creek, Jones Creek and Blair Creek are the major tributaries of the Rabbs Creek Watershed flowing to Rabbs Creek from the mine area. Topographic elevations range from approximately 350 to 480 feet above MSL. General elevation trends within the area reflect topographic highs at the northern and southern limits, while the central portion of the mine study area reflects a topographic low. The topography is moderately rolling, with the greatest relief occurring in the creek drainages of the southern mine area.

Topography of the Cummins Creek project area reflects the outcropping geology of the substrata. The basal Manning Formation intersects the surface as a gentle undulating plain. The Whitsett Formation exhibits conspicuous gentle sand hills, particularly in the southern portion of the project area. Near the Colorado River, the Whitsett Formation outcrops in steep bluffs bounding the erosional sides of the river. The Catahoula Formation typically forms a fairly continuous and commonly steep-sided sand ridge (Jackson and Garner, 1982). However, within the project area, the ridge is very gentle in slope and increases immediately beyond the area to the northeast and southeast. Section 3.6.3 presents the geologic setting in greater detail.

The overland conveyor would extend from the mine study area for about 12.1 miles to the FPP. The operating conveyor would be within a fenced 55-foot wide strip (65-foot easement) which is located approximately in the center of the 1-mile wide study corridor. The conveyor would cross several small drainages, the largest being Clear Creek, before crossing the power project's cooling reservoir (Cedar Creek Reservoir). Hellers Hill just east of the corridor is the highest topographic point (555 feet MSL) in the project vicinity. Topographical elevations range from approximately 370 to 540 feet above MSL along the conveyor route. The conveyor corridor traverses the Manning, Whitsett, Catahoula, and Oakville Formational outcrops.

Impacts of the Proposed Project

Excavation for FPP Units 3 and 4 will disturb approximately 210 acres. This includes the initial combustion by-product disposal area, areas for construction of the plant site lignite, fly ash and bottom ash handling areas, all pond construction and the construction of the units in the power block. The topography of this land would be permanently altered. Combustion by-products would be land filled in thirty acre cells to an above surface height of 35 to 65 feet.

Combined use of BWE's and draglines along with the associated reclamation techniques proposed for the Cummins Creek Mine would impact the topography of the area. Mine plan features for the project area include permanent overburden stockpile, the end lake, the surface water control structures and the temporary diversion and replacement of Cummins Creek. These are the major items which would effect changes from the pre-mine topography.

The most visible and most significant impact on topography would most likely result from the establishment of the permanent overburden stockpile. The permanent overburden stockpile would reach to maximum height of 130 feet above the original surface and have slopes of 5:1 or less.

LCRA's design of the permanent overburden stockpile was governed by a decision to minimize the use of undisturbed areas. As much overburden as possible is to be placed on mined Area #1, thereby limiting the extension of the stockpile to approximately 2,500 feet beyond the western limit of that area. The stockpile would consist of excess spoil material not required to achieve approximate original contour within the mine boundary while allowing for formation of the end lake.

The permanent overburden stockpile would be vegetated to coincide with landowner's post-mine land use preferences and to coexist with surrounding habitat. LCRA has contacted the landowners in the stockpile araa. All landowners contacted expressed a desire to retain control of their land after the stockpile has been constructed.

Other topographic impacts would include changes in location and size of waterbodies, recontouring related to overburden placement by the dragline in Area #2, leveling of existing slopes to minimize erosion and sedimentation problems, variable grading and leveling generally resulting in small highs and lows in the landscape and landscape modification to conform with post-mine drainage patterns.

With the exception of the permanent overburden stockpile, the overall topography will initially be higher due to a net 15% post-mine overburden swell. The impact of this swell should be minimal because the majority of settling should occur within a year after final placement. Some additional settling will occur during the next 5 to 10 years and settling after that should be minimal.

Minor topographic alteration would occur during construction of the conveyor. Placement of the culverts and development of the transfer station would create localized minor adverse impacts.

3.6.2 Soils

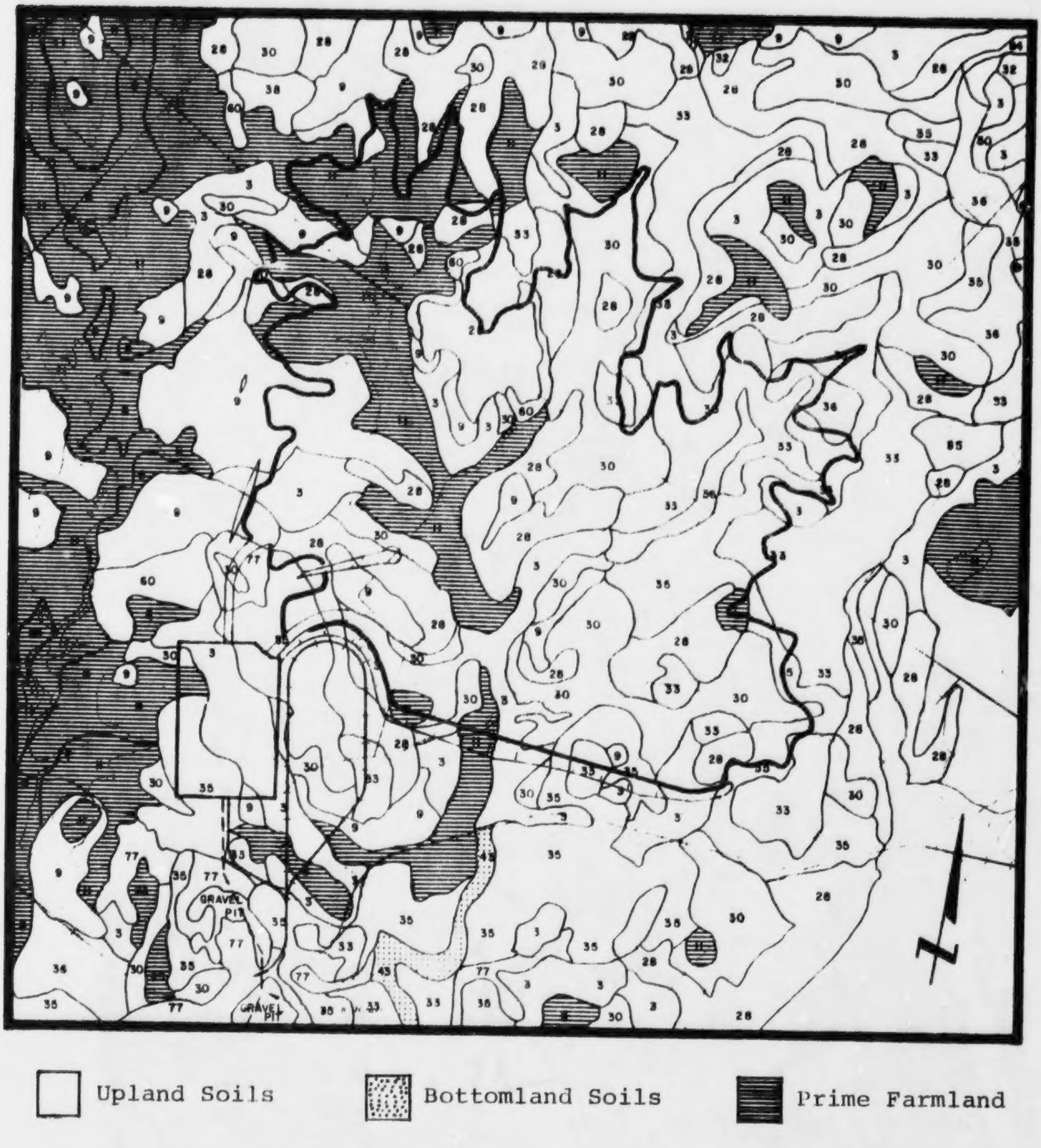
Existing Conditions

The FPP lies in a soil region that is generally classified as a Burleson-Heiden-Crockett Association. This association consists of deep to shallow calcareous clays that are characteristic of the Blackland Prairie (Godfrey 1973). In addition to these prairie clays, the FPP site also consists of sandy, loamy soils over clay while the lower portion of the site lies in the Colorado River floodplain which is composed of soils with loamy surface layers and clayey or loamy subsoils.

The U.S. Soil Conservation Service (SCS) conducted a detailed survey of the soil associations located on the project site and determined the approximate percentages of the major soil types in the upper and lower portions of the site (Figure 3-22). In general, prairie soils (mainly the Heiden Series) dominate the northwest portion of the site. The soils are firm, deep calcareous clays which are well-drained and have a very slow permeability and a high shrink-swell potential. The remainder of the upper portion of the site (north of the MKT Railroad) is sandy or

Figure 3-22

SOILS OF THE FAYETTE POWER PROJECT


GRAVEL PIT
GRAVEL PIT
Upland Soils
Bottomland Soils
Prime Farmland

SOURCE: EPA, 1979b

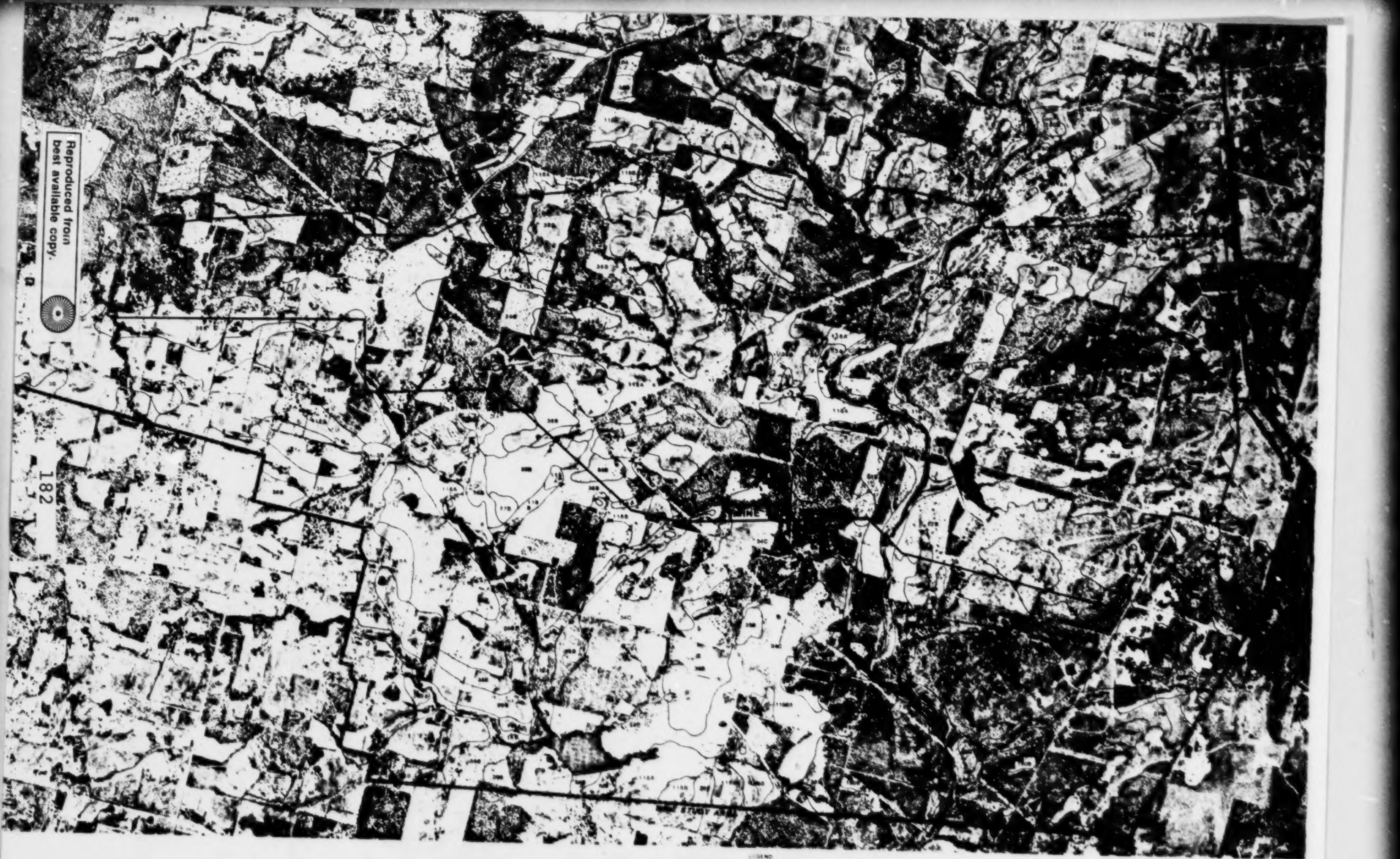

STUDY AREA
MINE

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Figure 3-23

LEGEND
0 - WATER
0
1000
2000

LOWER COLORADO RIVER AUTHORI
CUMMINS CREEK PROJECT

MINE STUDY AREA
SOIL MAPPING UNITS

E. B.
SEPT. 1983
1" = 1000'

Table 3-56
CUMMINS CREEK PROJECT
SOIL MAPPING UNITS

Map Symbol	Soil Name	Acres in Mine Study Area	Percent of Mine Study Area	Percent of Mine Area	Prime Farmland Soil*
3B	Wilson clay loam, 0 to 20 percent slopes	305	1.17	0.09	No
8B	Bleiblerville clay, 1 to 3 percent slopes	496	1.90	0.06	Yes
33B	Tremona loamy fine sand, 0 to 5 percent slopes	890	3.40	4.20	No
34C	Falba Variant loamy fine and, 1 to 5 percent slopes	5,827	22.28	24.54	No
35B	Burlewash fine sandy loam, 1 to 5 percent slopes	2,334	8.92	4.67	No
36B	Falba fine sandy loam, 0 to 2 percent slopes	5,418	20.72	21.28	No
54C	Padina fine sandy loam, 1 to 5 percent slopes	36	0.14	0.42	No
77B	Tremona very gravelly loamy fine sand, 0 to 5 percent slopes	4,032	15.42	18.63	No
77E	Falba and Tremona soils, 5 to 15 percent slopes	314	1.20	0	No
118A	Arol fine sandy loam, 0 to 1 percent slopes	2,083	7.96	8.40	No
118B	Arol fine sandy loam, 1 to 3 percent slopes	1,553	5.94	5.55	No
118B3	Arol fine sandy loam, 1 to 5 percent slopes	291	1.11	0.54	No
130B	Mabank Variant fine sandy loam, 0 to 2 percent slopes	10	.04	0	No
149	Bunyan soils, frequently flooded	1,014	3.88	3.17	No
150B	Tremona soils, graded, 0 to 5 percent slopes	1,189	4.56	8.08	No
151C	Shalba fine sandy loam, 2 to 5 percent slopes	31	0.12	0.13	No
152D	Shalba-Gullied land complex, 5 to 10 percent slopes	17	0.06	0	No
153A	Wilson clay loam, 0 to 1 percent slopes, terrace phase	16	0.06	0.24	No
W	Water	300	1.12	-	
Total	-	26,156**	100.00	100.00	

* These are prime farmland soils as defined in the Federal Register, Vol. 43, No. 21, Tuesday, January 31, 1978, Section 657.5(a), Revised May 1978.

** This acreage includes all lands within the Mine Study Area plus additional perpherial acreage categorized by the Soil Conservation Service.

Table 3-57
CUMMINS CREEK PROJECT
CLASSIFICATION OF CUMMINS CREEK SOIL SERIES*

Soil Series	Family	Subgroup	Order
Arol	Fine, montmorillonitic, thermic	Typic Albaqualfs	Alfisols
Bleiblerville	Fine, montmorillonitic, thermic	Udic Pellusterts	Vertisols
Bunyan	Fine-loamy, mixed, nonacid, thermic	Typic Ustifluvents	Entisols
Burlewash	Fine, montmorillonitic, thermic	Utlic Paleustalfs	Alfisols
Falba	Fine, montmorillonitic, thermic	Typic Albaqualfs	Alfisols
Mabank Variant	Fine, montmorillonitic, thermic	Typic Albaqualfs	Alfisols
Padina	Loamy, siliceous, thermic	Grossarenic Paleustalfs	Alfisols
Shalba	Clayey, montmorillonitic, thermic, shallow	Typic Albaqualfs	Alfisols
Tremona	Clayey, mixed, thermic	Aquic Arenic Paluestalfs	Alfisols
Wilson	Fine, montmorillonitic, thermic	Vertic Ochraqualfs	Alfisols

* SOURCE: USDA SCS, 1980

Table 3-58
CUMMINS CREEK MINE
CHEMICAL CHARACTERISTICS OF SAMPLED SOILS

Map Unit Symbol	Sample Site Designation	Depth (in)	pH	Conductivity (umhos/cm @ 25° C)	Cation Exchange Capacity (MEQ/100G)	Major Exchangeable Bases (MEQ/100G) Na	Ca	Mg	K	%Base Saturation	Soluble Metals (MEQ/100G) Ca	Mg	K	Na
118A	4	0-9	6.24	238	11.80	6.54	1.49	0.16	0.31	72	0.04	0.01	0.01	0.13
118A	4	9-65	6.62	1,250	29.40	19.29	5.36	0.22	2.25	92	0.09	0.03	0.01	0.65
118A	4	65-80	5.94	1,100	24.90	14.49	4.17	0.22	1.79	83	0.08	0.02	-0.01*	0.66
8B	12	0-10	7.58	982	66.70	0.18	77.26	1.82	1.12	100	0.57	0.02	0.03	0.06
8B	12	10-50	7.88	815	62.02	0.34	79.86	2.71	1.07	100	0.32	0.02	0.03	0.08
8B	12	50-72	7.65	842	51.60	0.73	76.23	3.08	1.19	100	0.29	0.02	0.04	0.17
149	11	0-15	5.37	86	4.43	0.11	2.78	0.73	0.11	78	0.12	0.05	0.03	0.07
149	11	15-39	5.42	189	9.63	0.17	7.33	1.60	0.13	93	0.13	0.01	0.01	0.08
149	11	39-80	7.02	40	1.06	0.08	0.60	0.10	0.04	70	0.03	0.01	0.01	0.03
35B	10	0-6	5.42	129	7.05	0.39	3.35	0.90	0.42	67	0.11	0.04	0.07	0.11
35B	10	6-25	5.62	850	47.13	2.82	27.90	8.38	0.65	81	0.28	0.13	0.03	1.04
35B	10	25-60	7.53	2,950	41.56	5.42	26.53	7.59	0.28	88	0.59	0.22	0.03	2.37
36B	2	0-10	5.26	78	3.20	0.96	0.32	0.04	0.15	46	0.04	0.01	0.01	0.06

* Minus sign (-) denotes "less than".

SOURCE: LCRA, 1984d

Table 3-58
(Continued)

Map Unit Symbol	Sample Site Designation	Depth (in)	pH	Conductivity (umhos/cm @ 25° C)	Cation Exchange Capacity (MEQ/100G)	Major Exchangeable Bases				%Base Saturation	Soluble Metals			
						Na	Ca	Mg	K		Ca	Mg	K	Na
						(MEQ/100G)					(MEQ/100G)			
36B	2	10-47	5.34	990	32.10	14.47	5.70	0.18	1.98	70	0.08	0.04	0.01	0.64
36B	2	47-60	7.11	1,270	20.50	13.14	4.78	0.24	1.81	97	0.11	0.04	0.01	0.76
36B	3	0-14	5.70	71	3.90	1.47	0.52	0.11	0.15	58	0.03	0.01	0.01	0.04
36B	3	14-36	5.63	500	37.00	16.44	6.13	0.32	0.99	65	0.04	0.01	0.01	0.22
36B	3	36-60	7.44	980	25.10	21.44	6.39	0.22	1.18	100	0.16	0.05	0.01	0.45
34C	7	0-14	4.94	26	2.60	1.09	0.28	0.06	0.14	60	0.03	0.01	0.01	0.04
34C	7	14-48	5.07	626	24.80	14.97	7.95	0.32	1.59	100	0.08	0.03	0.01	0.36
34C	7	48-72	7.29	1,340	21.70	12.02	5.48	0.18	1.53	89	0.08	0.04	0.01	0.85
34C	9	0-14	4.95	56	1.50	0.60	0.19	0.14	0.17	73	0.01	-0.01	-0.02	0.03
34C	9	14-69	6.17	755	18.20	6.65	3.55	0.14	1.32	64	0.04	0.01	-0.01	0.50
34C	9	69-84	7.32	816	7.30	3.04	1.80	0.06	0.80	78	0.06	0.02	0.01	0.63
77B	5	0-24	6.09	52	2.90	1.08	0.20	0.09	0.16	53	0.01	0.01	0.01	0.02
77B	5	24-55	4.19	520	25.80	9.56	4.49	0.21	0.84	59	0.06	0.02	0.01	0.37
77B	5	55-80	4.70	2,660	26.20	18.34	10.77	0.27	2.74	100	0.78	0.35	0.02	1.94
77B	8	0-25	6.08	41	2.40	0.73	0.18	0.05	0.18	48	0.03	0.01	-0.01	0.03
77B	8	25-52	4.06	2,020	26.20	13.80	7.48	0.21	2.70	92	0.25	0.11	0.02	1.33

Table 3-58
(Continued)

Map Unit Symbol	Sample Site Designation	Depth (in)	pH	Conductivity (umhos/cm @ 25° C)	Cation Exchange Capacity (MEQ/100C)	Major Exchangeable Bases Na	Ca	Mg	K	%Base Saturation	Soluble Metals Ca	Mg	K	Na
						(MEQ/100C)					(MEQ/100C)			
77B	8	52-80	4.12	2,530	24.90	12.81	5.36	0.18	1.78	81	0.61	0.26	0.02	1.94
118A	13	0-4	6.01	85	6.10	0.03	2.77	0.82	0.22	63	0.06	0.02	0.08	0.03
118A	13	4-8	5.15	61	5.40	0.07	1.54	0.57	0.12	42	0.03	0.01	0.03	0.08
118A	13	8-10	5.33	105	7.90	0.24	2.72	1.01	0.14	52	0.04	0.02	0.03	0.19
118A	13	10-16	5.51	402	18.40	1.29	10.80	3.18	0.15	84	0.25	0.24	0.10	0.74
118B	14	0-4	6.87	89	20.50	0.19	12.16	2.72	0.23	75	0.08	0.02	0.02	0.11
118B	14	4-16	6.52	66	41.00	0.64	20.57	4.08	0.34	63	0.11	0.10	0.04	0.12
36B	15	0-6	5.50	97	5.90	0.03	2.56	0.68	0.08	57	0.08	0.02	0.02	0.05
36B	15	6-12	5.80	46	2.40	0.18	1.38	0.30	0.04	80	0.03	0.01	0.01	0.04
36B	15	12-18	5.14	93	29.10	0.98	11.12	4.39	0.23	57	0.06	0.10	0.02	0.17
77B	18	0-10	6.27	131	2.80	0.05	2.42	0.29	0.06	100	0.13	0.02	0.02	0.08
77B	18	10-16	4.78	195	19.20	1.15	11.23	6.12	0.28	98	0.05	0.02	0.01	0.32

Table 3-59

CUMMINS CREEK MINE
PHYSICAL CHARACTERISTICS OF SAMPLED SOILS

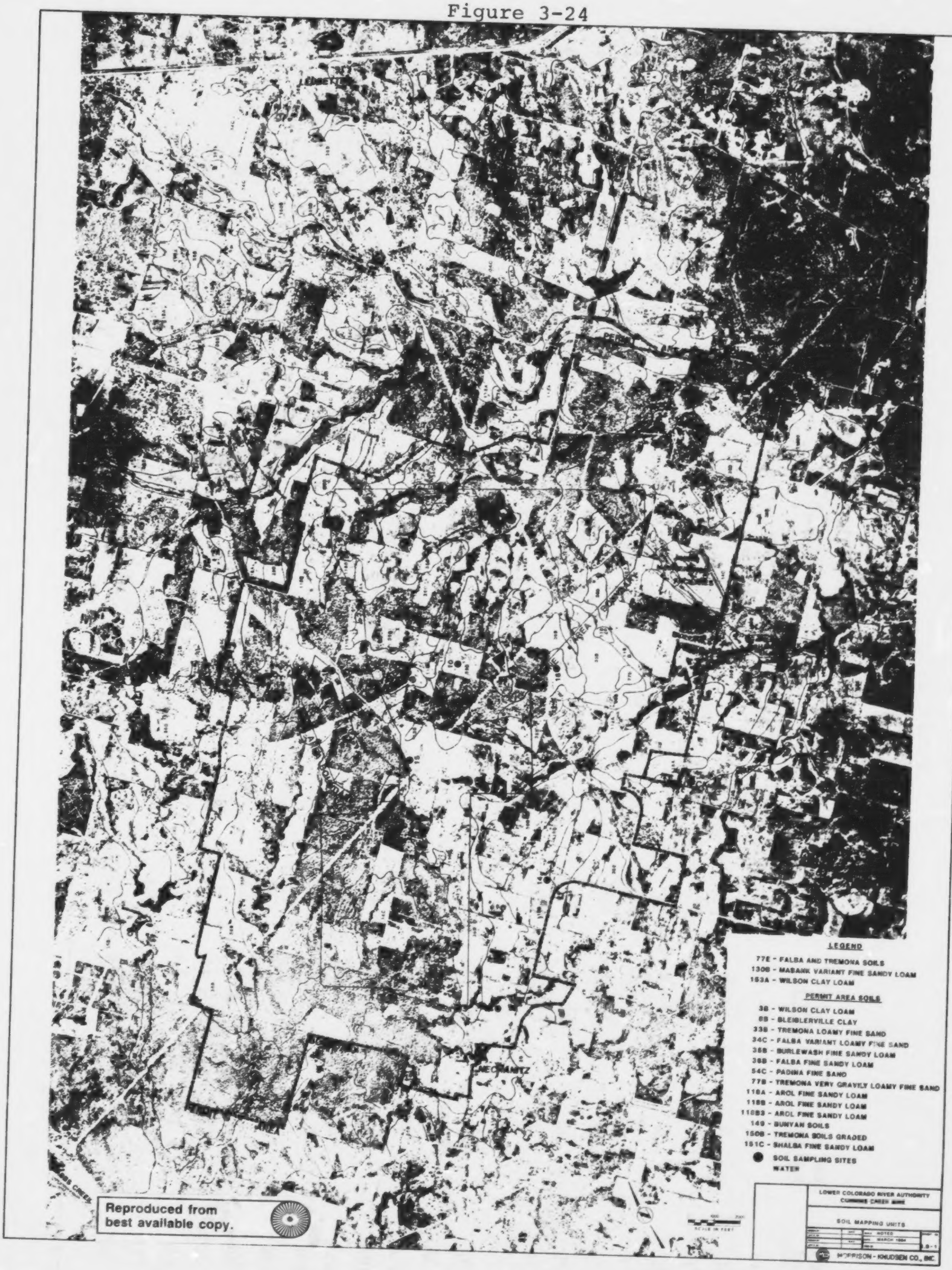
Map Unit Symbol	Sample Site Designation	Depth (In)	Sand (%)	Silt (%)	Clay (%)	Classification (Textural Class)	Water Holding Capacity		
							1/3 Bar %	15 Bar %	Available Moisture %
118A	4	0-9	58	29	13	Sandy loam	21.4	7.1	14.3
118A	4	9-65	36	26	38	Clay loam	40.8	17.2	23.6
118A	4	65-80	58	18	24	Sandy clay loam	27.6	12.9	14.7
8B	12	0-10	22	27	51	Clay	41.6	19.1	22.5
8B	12	10-50	16	20	64	Clay	49.3	22.1	27.2
8B	12	50-72	19	27	54	Clay	46.8	15.7	31.1
149	11	0-15	64	23	13	Sandy loam	8.3	2.4	5.9
149	11	15-39	58	22	20	Sandy clay loam	16.7	5.4	11.3
149	11	39-80	88	4	8	Loamy sand	1.0	0.3	0.7
35B	10	0-6	63	26	11	Sandy clay loam	11.9	3.0	8.9
35B	10	6-25	42	12	46	Clay	39.1	19.1	20.0
35B	10	25-60	49	17	34	Sandy clay loam	35.2	23.0	12.2
36B	2	0-10	75	21	4	Loamy sand	15.5	4.7	10.8
36B	2	10-47	50	15	35	Sandy clay loam	29.1	18.0	11.1
36B	2	47-60	66	10	24	Sandy clay loam	35.0	22.8	12.2
36B	3	0-14	68	27	5	Sandy loam	14.6	5.5	9.1
36B	3	14-36	51	18	31	Sandy clay loam	22.1	13.9	8.2
36B	3	36-60	54	17	29	Sandy clay loam	34.1	18.5	15.6
34C	7	0-14	79	19	2	Loamy sand	4.9	2.0	2.9
34C	7	14-48	41	13	46	Clay	39.7	21.4	18.3

SOURCE: LCRA, 1984d

Table 3-59
(Continued)

Map Unit Symbol	Sample Site Designation	Depth (In)	Sand (%)	Silt (%)	Clay (%)	Classification (Textural Class)	Water Holding Capacity 1/3 Bar %	Water Holding Capacity 15 Bar %	Water Holding Capacity Available Moisture %
34C	7	48-72	82	8	10	Loamy sand	19.0	12.5	6.5
34C	9	0-14	78	19	3	Loamy sand	6.5	2.2	3.3
34C	9	14-69	68	13	19	Sandy loam	13.5	6.1	7.4
34C	9	69-84	90	3	7	Sand	5.1	3.0	2.1
77B	5	0-24	81	18	1	Loamy sand	7.4	3.4	4.0
77B	5	24-55	49	11	40	Sandy clay	33.0	17.8	15.2
77B	5	55-80	45	17	38	Sandy clay	48.8	26.4	22.4
77B	8	0-25	88	12	1	Sand	3.8	1.9	1.9
77B	8	25-52	47	14	39	Sandy clay	35.5	24.0	11.5
77B	8	52-80	62	18	20	Sandy loam	26.5	20.5	6.1
118A	13	0-4	53	37	10	Sandy loam	16.4	4.7	11.7
118A	13	4-8	50	34	16	Loam	18.4	7.7	10.7
118A	13	8-10	41	29	30	Clay loam	26.3	18.1	8.2
118A	13	10-16	40	29	31	Clay loam	26.1	19.9	6.2
118B	14	0-4	30	47	23	Loam	27.5	15.0	12.5
118B	14	4-16	35	29	36	Clay loam	39.7	26.8	12.9
36B	15	0-6	63	28	9	Sandy loam	12.5	5.7	6.5
36B	15	6-12	71	24	5	Sandy loam	9.4	2.6	6.8
36B	15	12-18	51	15	34	Sandy clay loam	31.6	18.8	12.8
77B	18	0-10	84	11	5	Loamy sand	6.0	3.8	2.2
77B	18	10-16	53	6	41	Sandy clay	31.0	25.2	5.8

Figure 3-24


LEGEND
77E - FALBA AND TREMONA SOILS
130B - MABANK VARIANT FINE SANDY LOAM
153A - WILSON CLAY LOAM
PERMIT AREA SOILS
3B - WILSON CLAY LOAM
8B - BLEIBLERVILLE CLAY
33B - TREMONA LOAMY FINE SAND
34C - FALBA VARIANT LOAMY FINE SAND
35B - BURLEWASH FINE SANDY LOAM
36B - FALBA FINE SANDY LOAM
54C - PADINA FINE SAND
77B - TREMONA VERY GRAVELY LOAMY FINE SAND
118A - AROL FINE SANDY LOAM
118B - AROL FINE SANDY LOAM
118B2 - AROL FINE SANDY LOAM
149 - BUNYAN SOILS
150B - TREMONA SOILS GRADED
151C - SHALBA FINE SANDY LOAM
● SOIL SAMPLING SITES
WATER
LOWER COLORADO RIVER AUTHORITY
CUMMINS CREEK MINE
SOIL MAPPING UNITS
NOTED
MARCH 1984
MORRISON - KNUDSEN CO., INC.
SCALE IN FEET
LEDBETTER

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loamy sand dominated by the Crockett Series. These soils generally have friable, massive, fine sandy loam surface layers over a firm clay subsoil. They are moderately well-drained and have a very slowly permeable subsoil with a high shrink-swell potential. Between the railroad and U.S. Highway 71, soils are sandy or gravelly. They are well drained with moderately permeable lower layers that have high shrink-swell potentials. Below the railroad along Cedar Creek and extending into the broad floodplain of the Colorado River, soils are silty clay loams that are moderately well-drained with a very slow permeability.

USDA (1980) published a detailed soil survey of a portion of Fayette County surrounding the Cummins Creek mine. Through a cooperative agreement with LCRA, the SCS subsequently performed a detailed (2nd order) soil survey of additional land in accordance with the National Cooperative Soil Survey.

Ten soil series (18 mapping units) are found within the mine study area. Figure 3-23 identifies each soil unit within the area. Tables 3-56 and 3-57 summarize the mapping units and soil classification of the area soils, respectively. A description of each series is presented in the SCS Soil Interpretation Records (See Appendix D). Pedon descriptions of soils occurring in the project area (as determined from field samples) are also included in Appendix D.

LCRA collected representative bulk field samples to determine representative chemical and physical soil properties within the mine study area. The characteristics of representative soils sampled within and adjacent to the Cummins Creek 10 year mine permit area are presented in Tables 3-58 and 3-59. The soil sampling sites are shown on Figure 3-24. Chemical and physical analyses were conducted by Core Laboratories, Inc., Corpus Christi, Texas, using procedures listed in "Methods of Soil Analysis" (Black, 1965), Diagnosis and Improvement of Saline and Alkaline Soils" (USDA, 1969), and "Field and Laboratory Methods Applicable to Overburden and Minesoils" (EPA, 1978). Samples were analyzed for pH, electrical conductivity, texture, water holding capacity, cation exchange capacity, percent base saturation and major exchangeable basis, and soluble bases (Ca, Mg, Na and K).

Soils within the proposed mine area have a pH range of 3.5 to 8.4; surface soil pHs range from 4.5 to 8.4. Lime may be needed in areas where the surface soil pH is less than 6.5. No soils within the proposed mine area have electrical conductivities above 4 mmhos/cm. Therefore, excessive salts should not be a problem. The presence of carbonate in the lower part of some subsoils (especially Bleiblerville soil) gives those subsoils a base saturation of 100 percent. Cation exchange capacity and percent base saturation indicate surface horizons to be inherently low in fertility and are easily leached of nutrient reserves due to their predominate sandy to sandy loam texture and drainage characteristics.

Some of the data in Table 3-58 indicate that natric B horizons may exist for some soils. LCRA conducted additional sampling of soils which exhibited above average exchangeable sodium values. Results of the additional analyses indicated no excessive exchangeable sodium values (LCRA, 1984). See Appendix D.

Upland soils within the proposed mine area have clayey, loamy and sandy surfaces which rest abruptly over more clayey subsoils. Loamy surface soils occur over the major portion of the area. Some soils have large amounts of gravel which make up 35 to 75 percent of the surface horizons. Surface soils range from loamy fine sand and very gravelly loamy fine sand to fine sandy loam. The subsoils are mostly sandy clays and clays.

Some soils have gravel in the upper part of the subsoil which makes up 10 to 40 percent of these horizons. Parent materials range from tuffaceous (volcanic ash) silts, sands and clays to sandstone and quartz sands. In the north part of the proposed mine area, large amounts of gravel and sand have been deposited over these parent materials.

Permeability of these soils ranges from less than .06 to 20.0 inches per hour in the surface. Permeability for subsoils is less than .06 inch per hour except for the Bunyan series which ranges from 0.6 to 2.0 inches per hour. The erodibility of most of these soils is high except for the Bleiblerville series which is low to medium.

Shrink-swell potential of the soils within the mine study area ranges from low to high in the surface soils and low to high in the subsoils. If roads or foundations are placed directly on or in subsoils, selective construction procedures would be necessary to eliminate any possible problems.

LCRA also evaluated the ability and limitations of the soils in the mine study area. Tables 3-58 and 3-59 illustrate the properties of the soil mapping units within the Cummins Creek 10 year mine permit area. Most of the soils have average to below average productivity potential due to inherent physical and/or chemical characteristics. The highly-weathered, mainly upland soils do not produce well without such intensive management practices as regular fertilization, organic buildup, erosion control and possibly irrigation.

Of all the soils within the permit area, the Bleiblerville clay, an SCS designated prime farmland soil, and the Wilson clay loam seem to have the highest yield potential. All other soils have some productivity hinderance properties.

Major soil series that occur within the Cummins Creek mine study area will exhibit varying A (A_1) and E (A_2) horizon depths. These differences form form the basis for differentiating each soil into separate entities for classification purposes and for management concerns. Table 3-60 shows the average A and E horizon depths for each series within the 10 year Mine Permit Area. This information is based on the field sampling efforts that described individual soil profiles for each mapping unit in the permit area and based on SCS Soil Interpretation Record (Appendix D). Topsoil is classified as the uppermost soil horizon, or plowlayer, and is generally called the A horizon, a summation of the A (A_1) and E (A_2) horizons. It is also the soil layer that is the holding pool of the nutrient reserves available for plant growth and would be utilized at the Cummins Creek Mine as the uppermost portion of the post-mine reclaimed media. Topsoil depths vary from site to site, and final post-mine topsoil utilization will depend on site-specific data, not necessarily the depths generally shown in Table 3-60.

Table 3-60
CUMMINS CREEK MINE
AVERAGE THICKNESS OF A AND E HORIZONS FOR SOIL MAPPING UNITS IN THE PERMIT AREA

Map Symbol	Soil Name	Average Topsoil Depth (Inches)
3B	Wilson clay loam, 0 to 2 percent slopes	5
8B	Bleiblerville clay, 1 to 3 percent slopes	50
33B	Tremona loamy fine sand, 0 to 5 percent slopes	24
34C	Falba Variant loamy fine sand, 1 to 5 percent slopes	14
35B	Burlewash fine sandy loam, 1 to 5 percent slopes	6
36B	Falba fine sandy loam, 0 to 2 percent slopes	12
54C	Padina fine sand, 1 to 5 percent slopes	48
77B	Tremona very gravelly loamy fine sand, 0 to 5 percent slopes	24
118A	Arol fine sandy loam, 0 to 1 percent slopes	10
118B	Arol fine sandy loam, 1 to 3 percent slopes	8
118B3	Arol fine sandy loam, 1 to 5 percent slopes, eroded	4
149	Bunyan soils, frequently flooded	16
151C	Shalba fine sandy loam, 2 to 5 percent slopes	4

Only the Bleiblerville clay, 1 to 3 percent slopes, is identified by the SCS as a prime farmland soil within the permit area. The Bleiblerville soil location can be seen on Figure 3-23. This soil mapping unit covers 496 acres, or 1.9 percent, of the mine study area. The Bleiblerville clay soil in the mine permit area does not, however, meet the historical use criteria for consideration as prime farmland under the state surface mining regulations (RRC, 1983).

The proposed overland conveyor route is located entirely within Fayette County. As noted previously, a soil survey has not been published for Fayette County, and an intensive soil survey of the conveyor study area has not been completed. However, general soils information is available. Figure 2-7 presents the location of the alternative conveyor routes. This information and the following descriptions of the soil associations mapped in Figure 3-25 were taken from the general soils map of Fayette County (USDA, 1974).

The Heiden-Crockett Association consists of clayey and loamy soils which are gently sloping to rolling, deep, moderately alkaline and slightly acidic. This association makes up about 11 percent of the county. The majority of the project area falls within the Heiden-Crockett Association. Heiden soils, which make up approximately 50 percent of the association, are well drained, with very slow permeability and very high shrink-swell potential. Approximately 30 percent of the association consists of Crockett soils, which are moderately well drained and have a very slowly permeable subsoil with a high shrink-swell potential in the subsoil. The remaining 20 percent of the association consists of other soils.

A very small portion of the project area lies within the Arol-Crockett Association, which comprises approximately 8 percent of the soils in Fayette County. The Arol-Crockett Association is characterized as gently sloping, moderately deep and deep loamy soils which are medium acid to neutral. This association is made up of about 40 percent Arol soils, 25 percent Crockett soils (described above), and 35 percent other soils. Arol soils are somewhat poorly drained and have a very slowly permeable subsoil with high shrink-swell potential.

The northern portion of the project area lies within the Tabor-Axtell Association, which makes up about 22 percent of Fayette County. Gently sloping to sloping, deep, slightly acidic to strongly acidic, loamy soils characterize this association. The major component of the association is Tabor soils (40 percent), while Axtell soils (25 percent) and other soils (35 percent) comprise the remainder. Tabor soils are moderately well drained and have a very slowly permeable subsoil with high shrink-swell potential in the subsoil. Axtell soils are well drained and have a very slowly permeable and high shrink-swell potential subsoil.

Approximately 8 percent of the county and a small percentage of the project area are composed of the Vernia Association. Vernia soils have thick, very gravelly sand surface layers and gravelly sandy clay loam subsoils. They are undulating, deep, and slightly acid to mildly alkaline. Vernia soils make up about 70 percent of the association, with 30 percent being other soils. The well-drained Vernia soils have moderately permeable lower layers with low shrink-swell potential.

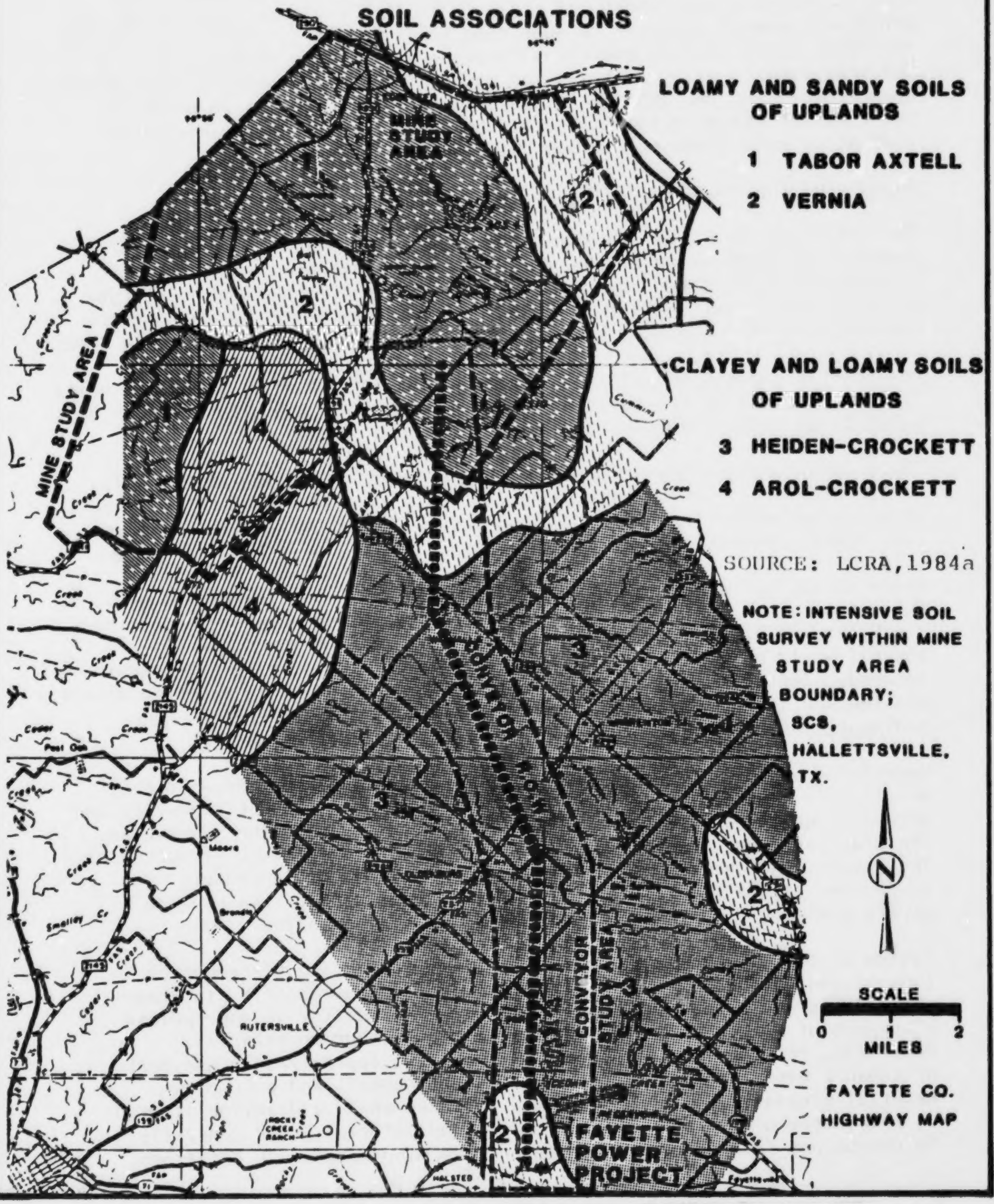

Figure 3-25

CUMMINS CREEK PROJECT
CONVEYOR STUDY AREA
SOIL ASSOCIATIONS

LOAMY AND SANDY SOILS OF UPLANDS
1 TABOR AXTELL
2 VERNIA
CLAYEY AND LOAMY SOILS OF UPLANDS
3 HEIDEN-CROCKETT
4 AROL-CROCKETT
MINE STUDY AREA
CONVEYOR STUDY AREA
FAYETTE POWER PROJECT
RUTERSVILLE
HALSTED
SCALE
0
1
2
MILES
N

SOURCE: LCRA,1984a

NOTE: INTENSIVE SOIL SURVEY WITHIN MINE STUDY AREA BOUNDARY; SCS, HALLETTSVILLE, TX.

FAYETTE CO. HIGHWAY MAP

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Overall, the soils within the conveyor study area are described by the SCS as having similar engineering properties, productivity and wildlife habitat suitability as those soils in the mine study area.

Preliminary soils mapping obtained from the SCS in Fayette County was used to estimate the amounts of prime soils that could be impacted by the proposed conveyor routes. Because some soils may be classified as the SCS finalizes soils mapping and classification in the area (Billington, 1983), the measurements of prime soils for each alternative should be considered approximate. Of the SCS preliminary mapping units considered prime in their native state, Heiden clay, Houston Black clay, and Bleiblerville clay occur most frequently along the proposed conveyor route.

Impacts of the Proposed Project

The principal effect of construction of FPP Units 3 and 4 and associated features on soils would be the potential for accelerated erosion. Exposed soils would be subject to erosion. This effect would constitute an unavoidable, but short-term adverse impact. Employment of appropriate erosion control techniques by LCRA would lessen the degree of adverse impact.

Few adverse impacts on soils would result from operation of the power units. However, the use of the soils within the power plant boundary would be dedicated to an industrial use for at least the life of the project.

The proposed mining operation would result in an alteration of the soils in the mine area. LCRA plans to reclaim this land to a productivity level equal to or better than that which currently exists as required by Texas Coal Mining Regulations.

Prior to any surface mining activity the land would be cleared and grubbed. Where topsoil is available, it would be removed using scrapers and either stockpiled or directly respread. Before topsoil is removed, depths of topsoil would be determined and suitable temporary stockpile sites would be located. Topsoil stockpiles would be constructed and revegetated to minimize erosion and sediment runoff. Overall adverse impacts of erosion and sedimentation should be minimized by LCRA's water control plan.

Underlying subsoil and overburden would be removed by the BWE - or the dragline in Area #2 and portions of Area #1. Around the pit conveyors and spreaders would be used with the BWE systems to relocate the overburden. The draglines would cast burden directly into the previously excavated area. The result would be a random mixture of both oxidized and reduced overburden strata from all depths with the lower half of the premine strata predominating the upper half of the postmine medium.

Design of the BWE system allows for much more selective placement of subsoil and overburden than with the dragline. Consequently, in areas where BWE's are used, LCRA should have more flexibility in appropriate placement of both desirable and undersirable overburden material. Generally, reclamation will be based on placing approximately one foot of topsoil over three feet of randomly mixed subsoil and overburden material excavated by the upper BWE. In cases where a dragline is used to remove the overburden, the randomly mixed material would generally be overburden from the lower portion of the mined area. In locations where topsoil no longer exists, e.g., gravel mining areas, overburden and subsoil would be randomly mixed and utilized as the growth medium.

In any case, special efforts should be made to identify potential unsuitable acid forming materials. Any unsuitable overburden would be covered with a minimum of four feet of suitable material, topsoiled (if available) and planted to species appropriate to the area. The potential does exist, however, for adverse impacts resulting from toxic material being placed at or near the surface. However, adherance to the reclamation plan should reduce the potential for major, long-term, adverse impacts from such occurrences.

LCRA does not anticipate any problems associated with natric horizons based on the most recent sampling data. However, if any problem with sodic materials arises, those materials would be buried. Under the proposed mine plan, it is likely that any sodic material discovered in the clay subsoils would not be exposed to the surface during reclamation.

Desirability of alternative growth media for use as topsoil would be determined from extensive sampling data of soils and overburden, from revegetation growth studies and/or from results of field test plots. Suitability of the alternative growth media for sustaining revegetation must be shown to be equal to or better than that of the available topsoil to comply with State surface mining regulations (RRC, 1983). In some instances the existing topsoil may not be suitable for topsoiling as other available soil materials.

Disruption of soil resources in the mine area will result in an adverse impact. The reclamation plan proposed by LCRA largely represents a mitigation plan for disruption of the resource. The degree of mitigation is dependent upon the success of the reclamation effort. LCRA's reclamation plan is thorough and is directed toward producing a satisfactory replacement to the strata that currently exists which would support vegetation at a level equal to or better than pre-mine conditions. In some areas, pre-mine conditions may be difficult to match without extensive efforts. In other circumstances, however, mining and reclamation may result in certain positive productive qualities. An example would be where existing dense clay pan subsoil would be replaced with oxidized overburden. This would allow deeper root penetration thereby providing more available soil moisture. Overall, the SCS has found that reclaimed land may provide a good soil resource (Thompson, 1984). Some reclaimed soil developed good structure and contain satisfactory chemical material in 3 to 5 years from the time of replacement.

The reclamation method proposed by LCRA does not provide as good an approximation of preexisting conditions as would be provided if topsoil, subsoil and overburden were replaced as before mining. Topsoil would be disturbed, but some important soil microbes should remain when the topsoil is replaced. Subsoil quality would be critical and would depend on the overburden source. As long as suitable oxidized overburden is used to replace the subsoil (approximately 4 feet) adverse impacts of acid forming overburden materials on plants at the surface or lower root zone should be reduced, thereby increasing overall reclamation potential.

Soil amendment (to create nutrient balance) and organic matter (to restore biological life) may be needed in varying degrees to achieve satisfactory revegetation of reclaimed lands. Chemical and physical analyses would be conducted by LCRA to determine specific fertilizer and possible lime requirements. The greater the resulting maintenance requirements are on any particular parcel of land, the greater the adverse impact would be on the particular landowner to maintain the productivity of the land after bond release. LCRA's plan to replace existing topsoil and to replace subsoil as much as possible with suitable oxidized overburden should contribute to reducing potential maintenance requirements. However, in areas where all overburden will be removed by draglines and mixed overburden would be used to replace the subsoil, soil amendment requirements and resulting short-term and long-term adverse impacts would be greater.

Operation of the Cummins Creek Mine would result in an irretrieveable loss of approximately 20 acres of Prime Farmland Soil (Bleiberville Clay, 1 to 3 percent slopes), constituting a long-term adverse impact.

LCRA has worked closely with the Fayette Soil and Water Conservation District (FSWCD) and the SCS in the development of its' mine reclamation plan. LCRA plans to continue a close working relationship with these groups and has entered into a Cooperative Agreement with the FSWCD relative to technical assistance on mine impacts land in Fayette County for land use planning and reclamation (See Chapter 4). Maintenance of such an agreement through the life of the project would serve to reduce potential adverse impacts on soils in the affected area.

Construction and operation activities associated with the development of the conveyor will result in changes in soil erosion rates, temporary loss of farmland, and localized changes in soil productivity.

Physical and chemical characteristics of the soils could also be changed during construction activities. It is anticipated that the texture and chemical characteristics of a given profile would become more homogeneous as a result of stripping, mixing, handling, and replacement activities. Runoff potential could increase during construction, but should decrease to near predisturbance levels after revegetation. Soil drainage should remain approximately the same although localized soil compaction will occur. The inherent water-holding capacity, in terms of porosity, pore geometry, and pore size distribution would not be altered by the conveyor operation.

Available topsoil in cut areas would be stripped and saved during construction activities. This topsoil would be stockpiled or respread and seeded as quickly as possible to help reduce fertility and erosion loss. During final reclamation of the right-of-way, the conveyor, roadway and fences will be removed; the land scarified, fertilized and seeded; and soil amendments added as necessary.

Construction and operation of the overland conveyor would result in the temporary (at least) conversion of approximately 26 acres of prime farmland soil to an industrial use. In most cases these soils should still maintain their prime farmland characteristics and be available for agricultural use when the conveyor system is removed at the end of the project life.

3.6.3 Geology

Existing Conditions

The project area lies in the Texas Gulf Coastal Plain. Geologic conditions, including the character of lignite deposits, are related to the depositional history of the region. During much of the Cenozoic Era, an alternating sequence of delta and river deposits was laid down by streams draining the Continental interior. The deposition occurred in the vicinity of the shoreline of the Gulf of Mexico, which fluctuated in location as a result of continual subsidence of the Coastal Plain and periodic uplift of land areas. The deltaic deposits consist principally of clay and silt, with minor amounts of sand and some lignite beds. The river (or fluvial) deposits are highly variable but principally consist of sand and gravel with lesser amounts of clay and silt and relatively minor lignite. Today these deposits are found in a series of formations which outcrop at the land surface and/or are found at relatively shallow depths.

Figures 3-26 and 3-27 present a geologic map and cross-section of the area, illustrating the location and relationship of the formations. Formation names and descriptions are provided in Table 3-61. For this EIS, the most important units are the Whitsett and Manning Formations, which are part of the Jackson Group of Lake Eocene or Early Oligocene age.

Recent surficial deposits overlie portions of the area, especially near modern streams. Elsewhere, the Coastal Plain sediments crop out in north and northeast trending belts, roughly paralleling the Gulf Coast. The formations dip southeast toward the Gulf at angles somewhat greater than the slope of the land surface. Near the proposed mine, the regional dip is a gentle 1 to 2 degrees to the east-southeast. Typically, the formations thicken and the angle of dip increases downdip (Rogers, 1976).

The northern portion of the mine area is overlain by thin Quanternary gravel deposits. These include flood plain materials, terraces along streams, and high terrace and gravel deposits. The latter are commonly exposed at the surface except at the very southern limit of the mine area. Beneath the Quaternary units are the Coastal Plain sediments, specifically the Catahoula, Whitsett and Manning Formations. A small portion of the Catahoula Formation outcrops near the eastern extremity, and extends eastward (downdip) from the mine site. The Catahoula reportedly reaches thicknesses of 500 feet immediately downdip of the proposed mine (Rogers, 1976).

The Whitsett Formation is the uppermost unit of the Jackson Group; in the subsurface it lies unconformably below the Catahoula Formation. The majority of disturbed acreage within the 10-year mine area is within the Whitsett Formation outcrop. A thick northeast trending and laterally continuous fine-grained cross-bedded sand is a principal characteristic of the lower portion of the formation in the mine area. The Manning Formation underlies the Whitsett except in the western and southeastern extremities of the mine area, where it outcrops at the surface.

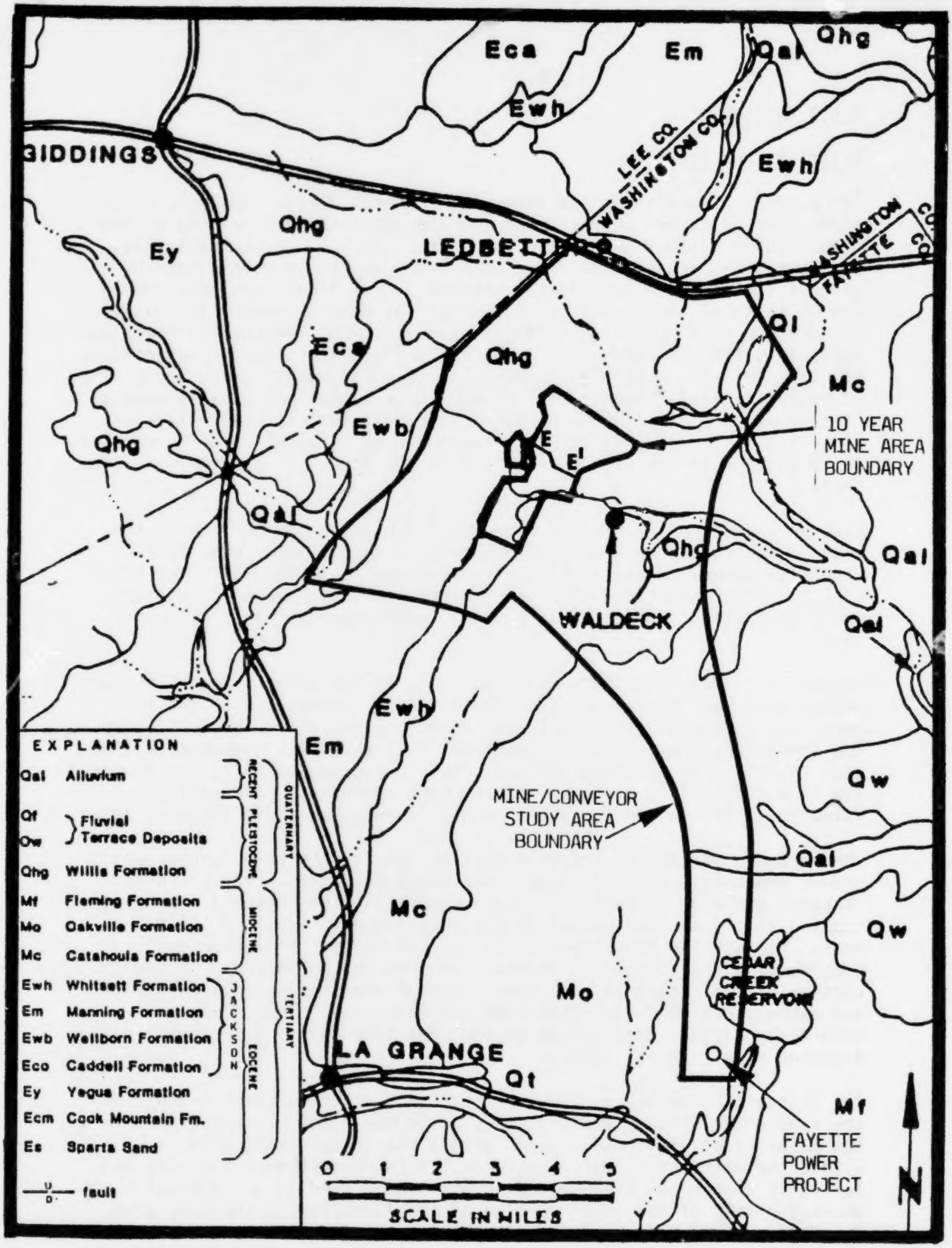

Eca
Em
Qal
Qhg
Ewh
GIDDINGS
LEE CO.
WASHINGTON CO.
Ewh
WASHINGTON
FAYETTE
CO.
CO.
Qhg
Ey
LEDBETTER
Ql
Eca
Qhg
Mc
Ewb
10 YEAR
MINE AREA
BOUNDARY
Qhg
E
E'
Qal
Qhg
Qal
WALDECK
Qal
Ewh
Em
Qw
MINE/CONVEYOR
STUDY AREA
BOUNDARY
Qal
Mc
Qw
CEDAR
CREEK
RESERVOIR
Mo
LA GRANGE
Qt
Mf
FAYETTE
POWER
PROJECT
N
0 1 2 3 4 5
SCALE IN MILES
EXPLANATION
Qal Alluvium
Qt
Qw
Fluvial Terrace Deposits
Qhg Willis Formation
Mf Fleming Formation
Mo Oakville Formation
Mc Catahoula Formation
Ewh Whitsett Formation
Em Manning Formation
Ewb Wellborn Formation
Eco Caddell Formation
Ey Yegua Formation
Ecm Cook Mountain Fm.
Es Sparta Sand
U
D
fault
RECENT
PLEISTOCENE
QUATERNARY
MIOCENE
JACKSON
EOCENE
TERTIARY

Figure 3-26 GEOLOGIC MAP. See Figure 3-27 for E - E' cross section.

Source: LCRA, 1984a.

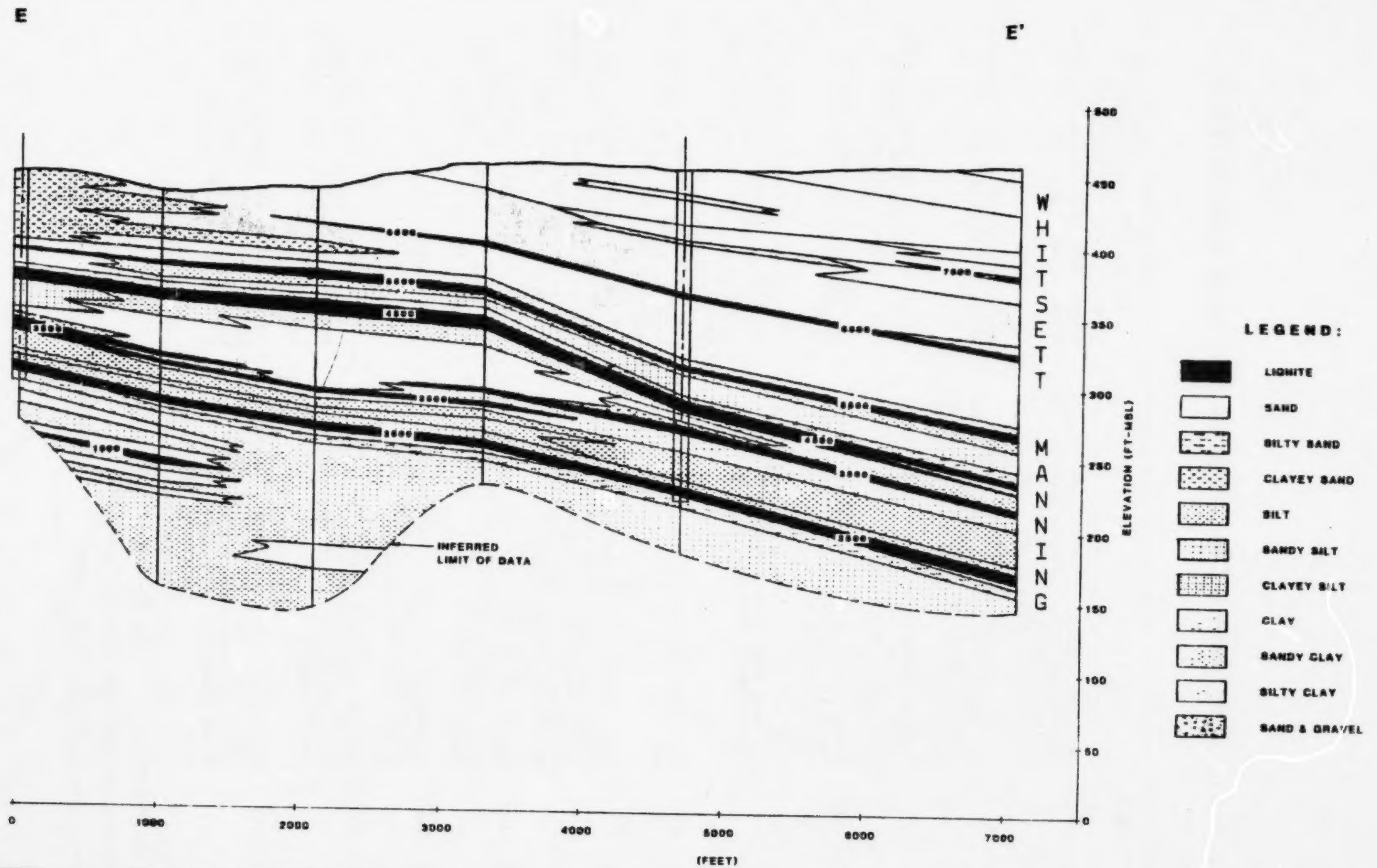

E
E'
WHITSETT
MANNING
INFERRED LIMIT OF DATA
ELEVATION (FT-MSL)
500
450
400
350
300
250
200
150
100
50
0
1000
2000
3000
4000
5000
6000
7000
(FEET)
LEGEND:
LIGNITE
SAND
SILTY SAND
CLAYEY SAND
SILT
SANDY SILT
CLAYEY SILT
CLAY
SANDY CLAY
SILTY CLAY
SAND & GRAVEL

Figure 3-27 STRATIGRAPHIC CROSS-SECTION, MINE AREA.

See Figure 3-26 for cross-section location.

Source: LCRA, 1984d.

Table 3-61 STRATIGRAPHIC UNITS AND THEIR WATER-BEARING PROPERTIES.

FORMATION	THICKNESS	LITHOLOGY	WATER - BEARING CHARACTERISTICS
Alluvium	0 - 60	Deposited along rivers and major tributaries; some gravel deposits on hilltops. Gravel, sand, sandy silt, clay, silty clay, and muddy gravel.	Yields fresh to moderately mineralized water in small quantities.
Fluvial Terrace Deposits	0 - 50	Terraces along streams commonly exposed to the surface; gravel, sand, silt, and clay in various proportions with gravel more predominate in older, higher terraces.	Yields fresh to moderately mineralized water in small quantities.
Willis	0 - 100	Siliceous gravel; fine to very coarse, poorly sorted, noncalcareous sand; indurated by silty clay.	Yields fresh to slightly saline water in varying quantities depending on type of material encountered.
Fleming	0 - 1300	Mostly silty clay, commonly calcareous; medium to coarse grained, calcareous, thick bedded sandstone.	Not known to yield water to wells in project area.
Oakville Sandstone and Lagarto Clay	0 - 950	Massive, cross-bedded sand and gravel lenses at base, grading upward into thinner-bedded sandy shale and clay.	Yields fresh to slightly saline water in small to moderate quantities. A principle aquifer. Supplies rural homes, irrigation, industrial and city wells.
Catanoula Tuff	0 - 500	Tuffaceous sand and sandstone interbedded with clay, silt, and tuff.	Yields fresh to moderately mineralized water in small to large quantities. Supplies city of La Grange.
Whitsett Manning Wellborn Caddell	0 - 250	Fine to medium grained, cross-bedded and cemented tuffaceous sands with minor constituents of clay, silt, lignite, fossilized wood fragments, sandstone lenses, and bentonic clay.	Overlying Whitsett yields low to moderate quantities of fresh to slightly saline water. Manning appears to be capable of yielding small quantities of saline water.
Yegua	0 - 1000	Non-persistent beds of fine to medium grained sand, alternating with shale and sandy shale and thin beds of lignite and gypsum.	Yields widely varying quantities and qualities of water for industrial, irrigation, livestock, and domestic purposes in and near the outcrop.
Cook Mountain	0 - 500	Predominantly clay and shale, with thin sandstone, limestone, glauconite, and gypsum lenses interbedded.	Not know to yield water to wells in project area.
Sparta Sand	0 - 275	Massive to cross-bedded, generally well sorted, fine to medium grained sand. A few thin beds of lignitic and micaceous shale occur throughout.	Yields small to moderate quantities of fresh to moderately saline water. Supplies domestic, livestock, irrigation, and public supply wells in Fayette County.
Claiborne	0 - 1000	Glauconitic sandstone and shale interbedded with silt, clay, and marl. The lower portion is fine to coarse grained, massive, cross-bedded, well sorted sand.	Not known to yield water to wells in Fayette County. Sand in lower part of formation probably contains fresh to slightly saline water locally.

Source: Rogers, 1976; Geologic Atlas of Texas, Austin Sheet, 1981.

System, Series, and Group for these formations found in Figure 3-26.

* These formations belong to the Jackson Group.

Lignite is a deposit of organic matter, similar in many ways to a compacted peat. At the mine site, lignites are found in the Jackson Group sediments. The Whitsett contains five lignite beds, ranging from 2 to 5 feet in thickness; the Manning contains seven lignite beds, ranging from 2 to 7 feet in thickness. The lignite horizons of the Manning Formation are thicker, have a higher thermal value, and are more laterally continuous than lignite horizons in the Whitsett Formation.

The deposits are typical of the extensive Texas lignites which are formed in the Eocene deltaic environment, much in the manner that modern peats are forming in the Mississippi Delta region. Most of the lignites in the proposed mine area are believed to have originated from swamp and extensive marsh deposits covering inactive delta lobes (Kaiser et al., 1980). Because of the constantly changing depositional and erosional environment, however, the lignite zones are characteristically thin, rarely as much as 10 feet and averaging less than 5 feet. The Manning Formation lignites generally are on top of mud or clay sequences which provided an excellent impermeable medium for thick swamp or marsh accumulation (deltaic deposit). Lignites in the overlying Whitsett Formation, a fluvially dominated deposit, are not as thick as the lignite in the Manning due to a less stable peat forming environment.

All LCRA computer work on the lignite involved assigment of a four digit code identification. Each lignite unit is assigned a number ending in 500, with 1500 representing the lowest unit and 2500, 3500, etc. referring to lignites progressively higher in the stratigraphic section. A total of eight lignites, representing the major resources, were assigned a 500-level number. Numbers not ending in 500 represent parting seams associated with the main lignitic horizons; for example unit 4400 would be below and unit 4600 above lignite unit 4500. Some of these parting seams may contain minor mineable resources.

Data on the major lignite units are provided in Tables 3-62 and 3-63; the data include thicknesses, tonnage, thermal-related properties, and physical and chemical parameters. Geochemical properties of the overburden and resulting impacts are discussed in Section 3.5.2.

Gravel beds attain thickness in excess of 15 feet north of the mine area where numerous abandoned gravel quarries and one periodically active quarry exist. The gravels exist only as a very thin (1 to 2 feet) surface veneer in the northern extremity of the mine area. Within the mine area, the main geologic resources are oil and natural gas found at depths in excess of 7,000 feet. Some shallow wells in Fayette County produce from depths in excess of 3500 feet which is well below the prospective mine floor (Rago, 1984). Intensive exploration and development of oil and gas in the project area began about 1977 and continues today; the surface is marked by numerous drill sites, averaging seven acres each, most of which contain an excess road, a pumping well, containment ponds, and/or storage tanks.

The near surface geologic formations existing within the conveyor corridor are dominated by the Oakville Sandstone which overlies the Catahoula Formation in eastern Fayette County. The Oakville outcrops along approximately two-thirds of the proposed conveyor route and at the Fayette Power Plant.

TABLE 3-62. CUMMINS CREEK MINE LIGNITE QUALITY, ALL MINEABLE HORIZONS.

Lignite Horizon	Average Thickness (Feet)	Lignite Quality			
		Btu/Lb	% Ash	% Sulphur	%Moisture
8500	4.50	3,277	24.0	1.7	45.2
8400	2.50	2,942	30.5	1.8	43.5
7500	4.85	3.758	22.4	2.0	45.0
7400	3.00	3,620	21.4	2.4	43.1
6500	3.14	4,333	15.5	1.8	47.8
5500	4.01	3,874	21.4	1.7	45.5
4500	5.75	4,346	18.9	1.9	45.2
4300	2.86	3,337	26.7	1.7	38.7
4200	2.17	3,532	26.1	2.4	37.7
3500	6.98	4,636	18.7	1.6	44.0
3400	2.72	3,431	28.3	1.2	40.1
2500	5.22	4,573	20.2	1.3	43.3
Reserve Averages (Weighted on Tonnage)		4,400	19.5	1.6	44.6

Source: LCRA, 1984a.

TABLE 3-63. CUMMINS CREEK MINE AREA IN-PLACE LIGNITE AND TRACE ELEMENTS, ALL HORIZONS.

Element	Number of Records	Minimum ppm*	Maximim ppm*	Mean ppm*	Standard Deviation
Arsenic	7	4.30	15.40	8.57	4.15
Beryllium	7	1.50	8.20	4.14	2.84
Boron	7	68.00	127.00	93.00	21.56
Cadmium	7	0.20	0.20	0.20	0.0
Chromium	7	4.00	15.00	8.14	3.53
Copper	7	5.00	14.00	8.71	3.64
Lead	7	8.00	18.00	11.71	3.20
Manganese	6	80.00	308.00	201.17	98.29
Mercury	6	0.08	0.25	0.15	0.07
Molybdenum	7	1.00	6.00	3.00	1.82
Nickel	7	1.00	15.00	7.14	5.08
Selenium	7	1.03	4.50	2.63	1.07
Uranium	7	2.00	5.00	3.57	0.97
Vanadium	7	12.00	49.00	25.28	11.73
Zinc	7	1.02	328.00	56.29	119.93
Sulfur Forms					
% Pyritic	19	0.05	0.31	0.18	0.12
% Organic	19	1.10	2.07	1.58	0.25
% Sulfate	19	0.00	0.06	0.02	0.02
pH, std units**	19	3.37	6.31	4.63	0.75

* Parts per million unless noted.

** Oxidized condition.

Source: LCRA, 1984d.

Proposed Units 3 and 4 of the Fayette Power Project overlie the Oakville Sandstone. The first saturated sand horizon is encountered at a depth of approximately 40 feet below ground surface. Although site-specific geologic data are minimal, soil boring data indicates this sand horizon is overlain by thick sequences of clay.

The project area experiences a low level of hazard from geologic processes. Slope stability is high, reflecting low angles and the common presence of sand and gravels. Seismic risk is nil, as the area is in Seismic Zone 0 (Hays, 1979). The closest fault expressed at the surface lies approximately four miles north of Ledbetter in Washington County (BEG, 1974).

Project Impacts

Geologic impacts could be significant if land disturbance caused by the proposed construction and operation reduced the value of geologic resources or increased the risks from geologic hazards.

Mine Area, 10- and 37-year Period. Impacts on geology are similar for all time frames and arise primarily from mine operation, which will modify the natural stratigraphy of the mined area. As overburden is stripped from the lignite seams, mixing will create a new heterogeneous material of unconsolidated sediments. This impact will be reduced somewhat above the 5500 horizon because materials will be handled by the bucket wheel excavator and relocated by spreaders in approximately the original lithologic sequence. Sand units above the 5500 horizon are expected to be reconnected to their original undisturbed units after mining (LCRA, 1984a). Stratigraphic units below the 5500 horizon will be excavated by dragline and thoroughly mixed. Stratigraphic disruption is a necessary consequence of mining and, in terms of geologic resources, is significant primarily with respect to possible consequences for ground-water hydrology; these effects are discussed in Section 3.5.2.

An irreversible and irretrievable impact will result from the depletion of lignite reserves in the mine area. It is expected 221.3 million tons of lignite will be removed over the expected 37 year life-span of the mine. This resource would be unavailable if, for example, more efficient means of lignite conversions are developed in the future. While oil and gas reserves will not be affected, several oil wells will be abandoned during mining. Another resource to be affected is the surface veneer of gravel which exists in the northern extremity of the mine area. Although the thickness and areal extent of gravel deposits are relatively minor, if the gravel is not salvaged during lignite mining, the resources would be irretrieveably lost.

Conveyor Area. Cleaning, grubbing, leveling, and construction of footings for the conveyor supports will result in localized long-term displacement of surface and shallow subsurface sediments. No adverse impacts on geology or geological resources are expected to occur as a result of the operation of the proposed conveyor system.

Power Plant Area. Construction of the proposed Units 3 and 4 and associated facilities will result in localized permanent alteration of the surface and shallow subsurface sediments. No adverse impacts on geology are expected to occur as a result of construction or operation of the power plant.

Impacts summary. The principal impacts involve disruption of natural stratigraphy at the mine site, which may affect groundwater; and the loss (recovery) of 221.3 million tons of lignite. No increase in geologic hazards should occur within the project area.

3.7 BIOLOGICAL RESOURCES

Existing conditions in the area are described in biological survey by LCRA and the Texas Parks and Wildlife Department (LCRA 1984a, LCRA 1984b, LCRA 1984c, Bounds et al. 1984). EPA review and independent peer review of these documents has generally found them to present acceptable methodologies and baseline data.

Existing Conditions

The study area lies along a transition from eastern water surplus to western water deficit environments. Thus, the area represents the westernmost limit of eastern deciduous forests and the easternmost extent of tallgrass prairie. Also, a few southern subtropical floral elements reach their northern limit in the area.

The major vegetation zones are Blackland Prairie and Post-Oak Savannah (Gould, 1975). Within these broad areas are four major vegetation communities and wildlife habitats: woodlands, cropland and pasture, riparian and aquatic systems. The largest communities are pasture (about half the area) and woodlands (about one-third); however in terms of biological significance and sensitivity, the riparian and aquatic areas are most important. Figure 3-28 depicts the relationship of the biotic communities and associated habitats to the three components of the proposed action (mine, conveyor, power plant). Brief, simplified descriptions of each community/habitat are provided; somewhat more detailed discussions are presented for sensitive habitats (wetlands) and endangered species. In all cases, more information - including details on field methodology and inventory results - is provided in the cited references. The additional information is especially important with respect to identifying secondary species and habitats which occur locally within the larger communities described below, and/or the overlaps which commonly occur between the communities. In all respects, the available information indicates that the study area is typical of surrounding regions.

Woodland. Woodlands cover about 12,470 acres or one-third of the total mine and conveyor study area of approximately 38,700 acres. The woodlands have a relatively open overstory dominated by post oak and blackjack oak, with other species including eastern red cedar and black hickory. Tree densities average 138 per acre with a mean spacing of 18 feet and a mean basal area per tree of 0.42 square feet. Canopy coverage ranges from 50 to more than 90 percent. It is believed that tree and shrub densities in this area have increased relative to the virgin condition (Gould, 1975). The typical understory reflects the influence

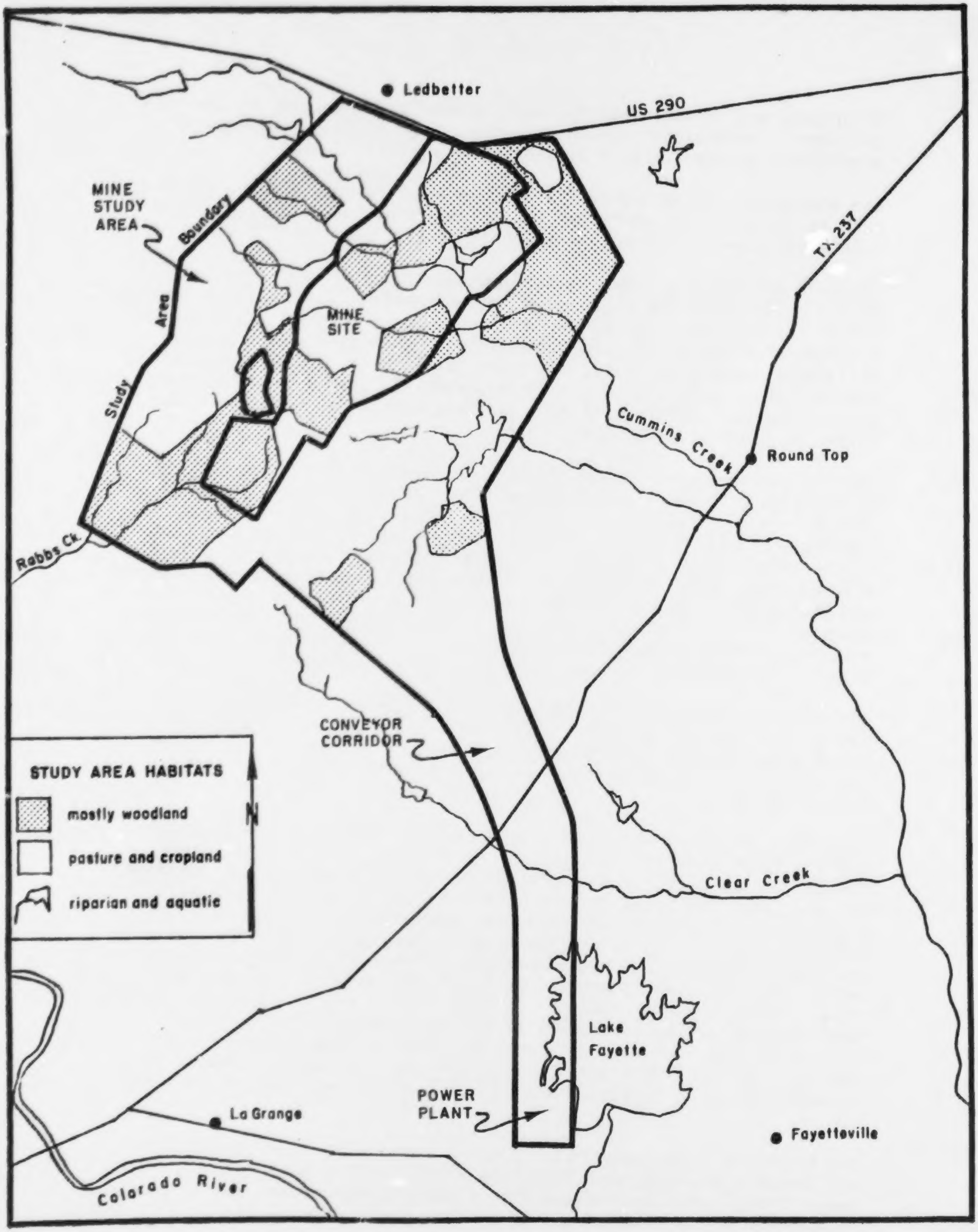

Ledbetter
US 290
TX 237
MINE STUDY AREA
Study Area Boundary
MINE SITE
Cummins Creek
Round Top
Rabbs Ck.
CONVEYOR CORRIDOR
STUDY AREA HABITATS
mostly woodland
pasture and cropland
riparian and aquatic
N
Clear Creek
Lake Fayette
POWER PLANT
La Grange
Fayetteville
Colorado River

Figure 3-28 DISTRIBUTION OF PLANT COMMUNITIES AND WILDLIFE HABITATS.

of grazing and is dominated by invading plants, especially shrubs such as yaupon. Occassional openings in the canopy allow dense grass development by species such as shortspike windmill grass.

The woodlands provide a modestly diverse wildlife populated by species such as fox squirrel, whitetail deer, armadillo, cottontail, raccoon, coyote and numerous birds, including cardinals, jays, warblers and robins.

Cropland and pasture. This community covers about 22,355 acres, or more than one half the study area. Minor croplands occur at the southern end of the mine study area. Primary crops are corn, oats, milo and sorghum-sudan grass. Average corn yield is 30 bushels per acre, reflecting low productivity. Oats are utilized for winter forage and grazing, while milo and sorghum-sudan grass are grazed in the summer and cut for hay. Historical data indicate that some of the area was farmed for cotton and peanuts.

Pasture includes some managed areas which are fertilized and rather productive, with hay yields ranging from 1.5 and 2.0 tons per cutting with 2 to 4 cuttings per year. Bermuda grass or brownseed paspalum typically covers 95 to 97 percent of these pastures. Other areas are little managed and, while bermuda grass is dominant, overgrazing has allowed invasion of weedy species such as goatweed, bitterweed, ragweeds and broomweed. These plants are unpalatable to livestock and in many cases have become so abundant as to limit the growth of useful forage grasses. Unused grazing land is undergoing secondary succession, with invasion of seedlings of post oak and eastern red cedar.

The pasture provides a limited habitat for mammals, with jackrabbits and various rodents being the most common species. Bird populations are diverse, however, and include game species such as mourning dove and bobwhite quail as well as numerous songbirds and species such as the cattle egret.

Riparian. Riparian or stream-side areas are relatively small in total acreage (600 acres) but significant in diversity and habitat value. Narrow corridors of bottomland hardwoods extend along most of the area's streams; dominant trees include water oak, cedar elm and green ash. A shorter secondary canopy is typically dominated by red mulberry. Understory vegetation is relatively well developed; yaupon is common to extremely abundant, and numerous other shrubs such as American beautyberry, possum haw and southern black haw ocur as well. Woody vines (e.g., supple-jack, trumpet creeper and others) are abundant and can make passage through this vegetation type difficult. Ground cover along the creek margins consists principally of inland sea oats and sessile flowered spikegrass (C. sessiflorum). Occasional open areas support more weedy species, such as black willow, buttonbush and many others.

The trees are large (mean basal area of about 0.7 to 1.4 square feet and variably spaced), with densities of 50 to 115 trees per acre. These ranges reflect the diversity of the riparian areas; smaller, more closely spaced trees are found along the smaller, seasonally dry drainages.

The wildlife population of the riparian zone reflects its diversity. Most of the area's mammal and bird species visit this habitat regularly; for example, white-tailed deer have their highest density in this habitat, at about 30 animals per 1000 acres. In addition, the area includes various reptiles and amphibians associated with adjacent aquatic habitats.

Aquatic. Aquatic areas total 1015 acres. The primary aquatic habitats are the Cedar Creek Reservoir and SCS impoundments and the scattered permanent pools in intermittent streams. Also, below the reservoir, Cedar Creek is a permanently flowing stream. The permanent water is typically bordered by aquatic plants such as rushes and water primrose, with green algae and diatom phytoplankton assemblages being most common in open water; rotifers dominate the zooplankton community. Benthic species for flowing streams, impoundments and natural pools include larvae of mayflies, midges, dragonflies and other insects along with various crustaceans such as fresh-water prawns. Overall the species are indicative of unpolluted water. The aquatic areas and their riparian margins are prime habitat for varied frog, toad, turtle and lizard species. In addition, Cedar Creek Reservoir is an important waterfowl habitat.

Fish species are typical of a bass-bluegill system. Dominant species in the mine area (especially the SCS ponds, which contain the greatest numbers and largest individuals) are bluegill, gizzard shad, largemouth bass, golden shiner, mosquitofish, black crappie and redear sunfish. These species all appear to be in good condition with balanced populations, although overall diversity is relatively low. In the reservoir and Cedar Creek area, small forage fishes dominate, including various shiners, sunfishes and shads. In the lake, largmouth bass in the predominant sportfish; in 1983 the bass harvest was approximately 12 pounds per acre.

Other communities. Active and abandoned gravel pits along with oil well sites, roads and other highly disturbed areas make up less than 3 percent of the study area, or about 1,990 acres. These areas have a sparse vegetative cover dominated by weedy or grassy species. In areas where disturbance is no longer active, seedlings of post oak, eastern red cedar and other climax plants are becoming established.

General Wildlife Ecology. Information on wildlife populations from an ecological and economic standpoint is taken from LCRA, 1984a and 1984d. Wildlife population sizes and species diversities vary considerably within the mine/conveyor study area. Aquatic invertebrate communities show diversities and species compositions similar to lands adjacent to the study area. Wildlife resources contribute to the attractiveness of the region in terms of economic game species, although study area land is generally in private ownership.

Bird communities show their lowest diversities but greatest numbers in the pasture and old field areas. The highest bird species diversities were found in the woodland and riparian habitats. Dove densities vary within the study area but are comparable to adjacent lands. The southern portion of the conveyor study area has the greatest densities of mourning dove. Bobwhite quail densities in the study area are lower than average for Fayette County.

White-tailed deer density averages approximately 10 deer per 1,000 acres, ranging from less than 5 up to 30 deer per 1,000 acres. The greatest densities are found in the raparian habitats. All calculated densities are less than the 34.8 deer per 1,000 acres as calculated for the Post Oak Savannah Ecological Region by the Texas Parks and Wildlife Department.

The mine study area appears to have lower coyote, raccoon and skunk densities than surrounding areas, but fox, feral dog and cat, opossum and armadillo densities are higher. Rodent sampling indicates average densities relative to surrounding areas, with lower densities near the power plant.

Fish populations in study area ponds are in good condition but overall diversity is low. Fish communities of the creek systems are comparable to those outside the study area in terms of density and diversity. Creel surveys indicate that Cedar Creek Reservoir is a valuable recreation resource for largmouth bass fishing.

Sensitive or Regional Habitats. No parks, preserves, or wildlife refuges occur in or adjacent to the study area. However, regionally isolated pine forest extends into the proposed mine area. Riparian woodlands also occur in the mine area, and while small in area their diversity of vegetation and consistent supply of water make them important to wildlife in the immediate area.

Wetlands. Review of effects of Federal actions on wetlands is provided under Section 404 of the Clean Water Act (CWA) and Executive Order 11990 (1977). Wetlands are defined as areas that are inundated or saturated by ground or surface water at a frequency and duration sufficient to support (and that under normal circumstances do support) a prevalence of vegetation adapted for life in saturated soil conditions. Specific identification of wetland areas requires consideration of vegetation, soils and hydrology.

The riparian association represents the only plant community approaching the Section 404 definition of wetland. Two specific potential areas have been noted in the mine vicinity: potential marsh or swamp land in the headwaters of SCS Reservoir #5 (Turkey Creek drainage) and the Cummins Creek drainage. The U.S. Army Corps of Engineers, Galveston District, conducted a wetland survey of the Cummins Creek Project Area on March 1, 1983. The nature of the terrain is such that there are no Section 404 jurisidictional wetlands outside the cutbanks of the stream channels (see Chapter 4 for CE, 1985) (See also Section 2.12).

Threatened and endangered species

The only plant communities or wildlife habitats identified that may be unusual or unique to the project area are the remnant Little Bluestem-Indiangrass prairie and possibly the Eastern grammagrass-switchgrass lowland grasslands. These two grasslands are highly endangered according to the Texas Natural Heritage Program and are likely to occur south of the project site and near Carmine which is just east of the proposed mine site. Only fifteen known remnants of this prairie type exist (Smeinnes and Diamond, 1983). Potential adverse impacts of these grasslands, if they exist in the area may be reduced by exercising care in placement of support facilities and by careful routing of the conveyor belt. Impacts to grasslands located over lignite to be mined would be unavoidable. It may be appropriate to request personnel from the Texas Natural Heritage Program to survey the mining area prior to the commencement of construction activities.

The study area contains habitat with the potential to support several of the sensitive wildlife species that may occur in the region as listed by LCRA (1984a) including: American alligator, bald eagle, Texas horned lizard, Mexican and Louisiana milk snakes, interior least tern, osprey and wood stork. However, habitat quality has been judged suitable only for limited transient or migratory use (LCRA, 1984a). Actual observations have identified only the wood stork (Mycteria americana) as an area visitor; no evidence of nesting has been observed. Local records provide no evidence that the other species listed are likely to be found in the area.

For example, the Houston toad occurs in Bastrop and Buescher State Parks and surrounding areas. The total population of the Houston toad, which has been listed as endangered since 1970, is roughly 1,000 to 1,300 individuals (U.S. DOI, 1978). No specimens have been collected in Fayette County (Raun and Gehlback, 1972). Similarly, the bald eagle is known to nest in Texas, but nesting is largely confined to the coastal region and to large bodies of water. No sightings were reported for Fayette County during 1971 to 1973 (Smith, 1974). The bald eagle could pass through the project area in migration and possibly could winter there. The peregrine falcon is not a resident of the site, but individuals could pass through the area in migration and could occasionally winter there. Only one fish, the blue sucker (Cycleptus elongatus), that is a protected non-game species, was listed by LCRA (1984a) in the area of Lee, Fayette and Washington Counties. No state or federal threatened or endangered aquatic species were found to occur in these three counties. Since the creeks in the permit area are shallow and intermittent with high suspended solids loads, they are not likely to provide a suitable habitat to sustain the blue sucker. No specimens of this species were collected during LCRA field surveys.

In accordance with Section 7 of the Endangered Species Act, as amended, the U.S. Fish and Wildlife Service (USFWS) was contacted to identify any plant or animal species or habitats that are listed or proposed for listing as endangered or threatened within the study area. The USFWS sent a letter to EPA dated July 3, 1984, which indicated that no threatened or endangered species nor critical habitats are in Fayette County; a copy of the letter is included in Chapter 4. However, the USFWS has identified threatened and endangered species, such as the Houston toad, in nearby counties which may be affected either by deposition of air emissions or by pollution of surface water from flooding conditions or inadvertent discharges. These possible impacts are addressed in the following sections.

Mine Construction and Operation

General Terrestrial Impacts. Support facilities for the mine, such as buildings, roads, and equipment erection sites, would be required throughout the 37 year life of the mining operations and would disturb an estimated total of 2,136 acres. Minor, adverse impacts to wildlife would result during construction of these facilities. The existing vegetation and habitat would be removed and wildlife would either be destroyed or displaced. Wildlife would be displaced to adjacent areas away from active operations which would result in at least temporary increases in local wildlife population densities in those adjacent areas. Noise and activity around the support facilities would also disperse wildlife.

The greatest direct adverse impact to wildlife during the lifetime of the project would be from the mine itself. During the 37 years an estimated 7,450 acres would be mined. This would include complete habitat removal and alteration of the existing site ecosystem. Wildlife would be eliminated in the active mining areas followed by the slow re-establishment of some wildlife after reclamation. No more than 2,300 acres would be disturbed from the mine during any one year. Assuming the same proportion of vegetation types and land uses occurs within the active mine area and support facilities as occurs in the 25,100 acre project area, then about 3,500 acres of woodlands, 5065 acres of pasture, 195 acres of riparian association, 88 acres of cropland, and 187 acres of water would be removed during the lifetime of mining activities. Within the mined area the reclamation plan is to establish post-mining land uses that are in about the same proportion as presently exists. The main exception to this is the proposed establishment of the 845 acre end lake which would result in less post-mining acreages of other land uses.

Land clearing would result in habitat removal as described earlier. From the time of clearing to re-establishment of ground cover, mining areas would essentially be totally absent of wildlife due to the complete removal of habitat. Wildlife species would either be displaced to surrounding unaffected habitat or be destroyed by mining machinery. Local population densities of wildlife in the unaffected peripheral habitat would temporarily increase due to the sudden influx of displaced animals. No assessment has been made of the carrying capacity of nearby areas. Assuming this habitat is at or near its carrying capacity, natural regulating mechanisms would return wildlife densites to near premining levels. Clearing activities would also disturb surrounding fauna with increased human activity and noise. Stress on various animal populations near the mine resulting from overcrowding and nearby mining activities may cause decreased reproductive success and increased mortality, both of which are natural population regulating mechanisms. These adverse effects would be localized and temporary, ameliorating as mining moves on and reclamation progresses.

Habitat Evaluation. Other than the riparian habitat and water areas, particularly Cummins Creek, the most valuable wildlife habitats are the woodlands and transition areas between woodlands and pasture. LCRA conducted an evaluation of the existing and projected post-mining habitat quality (see Appendix F). This type of evaluation has been increasingly used during the past five years in environmental assessments. It is largely a subjective procedure that rates the average quality of each type of existing habitat, and multiplies that rating by the area of each habitat to achieve a value called habitat units. These units are summed to obtain an overall habitat value. The total estimated habitat units for existing conditions (year 0) are 32,694. About half of these units are in the woodlands category as shown in Table 3-64a. Three alternative projections are shown in Table 3-64b. These projections are for worst case reclamation conditions to pasture (Alternative 1), an intermediate reclamation to range (Alternative 2), and a best case reclamation to pasture (Alternative 3).

LCRA projections are that during active mine operation (years 15 and 30) habitat quality would decrease in pasture, cropland, and water zone values. The projections for post-mining conditions indicate increased habitat values over existing conditions in all categories in Table 3-64a except the minor decreases in cropland and odd areas. This evaluation is based on several optimistic assumptions. For example, the habitat rating for each of the categories is increased which means it is assumed that after reclamation the quality of each type of habitat would be better than present conditions. Pasture values are projected to increase as a result of the invasion of annual and perennial forbs with no decrease in the condition assumed after active reclamation ceases. Range values were rated fair under present conditions to increase to excellent after 45 years. Woodlands are projected to increase in rating from 4.7 to 6.5 because species groups would increase despite the fact that they can take the longest time to be reestablished and that after active management the quality of the woodlands may tend to deteriorate more closely to current conditions or even less if improved soil conditions are not established. It is doubtful that the long-term carrying capacity of the revegetated woodlands would remain greatly above pre-mining conditions.

For present and future conditions of water areas, only pond and reservoir water zone habitats were considered in establishing the habitat rating. The streams were omitted since they are intermittent. The end lake is given a high rating compared to existing water habitat quality. For example, water quality in the lake is assumed to be as good as exists in Cummins Creek, which does not account for decreased water quality which may occur in the lake from leaching or seepage of elements such as selenium from the sides and bottom. Also, changes in submerged and emergent vegetation acreages are not quantified. Reestablishment of bank habitats is difficult, at best, and there are no proven methods for streams. It may be decades before the recut stream channel stabilizes, in which case stream bank habitats may not be of higher quality than currently exists. Techniques are more reliable for establishing pond bank habitats, and these reclamation projections are more realistic.

The habitat evaluation procedure used was developed for conditions in Kansas but was modified to reflect habitats in Texas. The riparian habitat was considered as part of the woodland habitat yet due to its ecological value a separate evaluation may have been appropriate. The aquatic habitat evaluation could have included conditions in area streams before mining and after reclamation.

TABLE 3-64a

HABITAT EVALUATION UNITS AND ACREAGES FOR PRESENT CONDITIONS AND YEARS 15, 30 AND 45 IN THE MINING AREA

Land Use	Habitat Rating	Year 0 Units/Acres	Year 15 Units/Acres	Year 30 Units/Acres	Year 45 Units/Acres
Pasture	3.6	9,810/2,725	6,298/577	8,331/1,825	12,725/2,545
Cropland	2.9	14/5	0/0	0/0	0/0
Range	3.3	3,036/920	2,447/35	3,742/445	5,096/730
Woodland	4.7	16,427/3,495	18,447/1,710	16,343/2,902	22,581/3,474
Water Zone	5.5	825/150	657/30	462/50	6,370/980
Bank Zone	4.0	100/25	130/10	75/15	150/25
Odd Areas	3.4	2,482/730	2,594/42	1,626/100	888/296
TOTAL		32,694/8,050	30,573/2,344	30,579/5,337	47,810/8,050

Source: (LCRA, 1984a; LCRA, 1984b)

TABLE 3-64b
ALTERNATIVE HABITAT UNITS
PROJECTIONS FOR ULTIMATE CONDITIONS (YEAR 45)

CATEGORY	ACREAGE	ALTERNATIVE					
		1		2		3	
		Rating	HU**	Rating	HU**	Rating	HU**
Pasture/ Range*	7,045	3.5	23,658	5.0	35,225	6.25	44
Water Zone	980	6.5	6,370	6.5	6,370	6.5	6
Bank Zone	25	5.0	125	5.0	125	5.0	
TOTAL	8,050	-	31,153	-	41,720	-	50

* For Alternative 1 the 7,045 Acres will be reclaimed to pasture (well maintained Coastal Bermudagrass monoculture), and in Alternatives 2 and 3 the 7,045 acres will be reclaimed to range land. Alternative 2 is of fair quality, has a section of forbs and/or woody plants, and no excessive use. For Alternative 3 the range includes increased areas of woodlands.

**HU=Habitat Units

Source: LCRA (1984b)

The habitat evaluations in Table 3-64b include an alternative habitat value projection for reclamation to pasture land (Alternative 1). This alternative projection could even be lower if the monoculture Coastal Bermudagrass for wildlife was assigned a value of 3.0, which would result in total habitat units of 27,630 in year 45. This presumably represents a "worst case" projection and would be a decrease of 16 percent in habitat quality.

For the second alternative (reclamation to range of fair value for wildlife habit) a rating of 5.0 is given. In the event of local overgrazing the rating would decrease to 4.0 with total habitat units of 34,675. This would represent a small increase (approximately 6 percent) over present habitat quality.

In the "best" projection, Alternative 3, with reclamation to rangeland with increased woodlands the ultimate habitat units would total 50,526 as compared to a present rating of 32,694. This would result in a 55 percent increase in habitat value for the area.

It may be appropriate to monitor the quality of the various habitats (in particular riparian and woodland) in years 15, 30, and 45 to determine success of reclamation based on projected habitat units.

Reclamation. To the extent possible, using the best technology currently available, the Lower Colorado River Authority is required to minimize disturbances and adverse impacts of its activities on fish, wildlife and related environmental values, and achieve enhancement of these resources where practicable (RRC, 1983). The planned reclamation efforts would result in restoration of soil characteristics suitable for re-establishment of vegetation according to specific regulations. Land contours and drainage patterns would be restored to pre-project conditions in most areas, excluding the permanent over burden stockpile and end lake.

For pasture land, revegetation with a monoculture of Coastal bermudagrass has been proposed. Since this species requires fertilization and active management, other species of grass that do not require as much management could also be used to increase the long-term chances of successful revegetation. Such species could include kleingrass, Selection 75; lometa indiangrass; medio bluestem; Gordo bluestem; Alamo switchgrass; or weeping lovegrass (SCS, 1984). Planting of tree clumps (3-5 trees/clump) is also proposed by LCRA. The key tree species in these plantings would be post oak; persimmon, mulberry, plum and other species would also be appropriate.

The mining consultant (Morrison-Knudsen) has considerable experience with reclamation in other mining areas including, for example, the Gibbons Creek Mine located about 50 miles to the northeast. They have demonstrated at that mine that they can successfully revegetate most of the types of habitats within this mining area. The long-term success of reclaiming woodlands is questionable as indicated above. Reestablishment of natural species diversity and relatively complex community structure characteristic of these ecosystems would depend to a large extent on natural succession. The only unusual terrestrial feature is the permanent overburden stockpile, which should not present any unusual revegetation problems except for possible erosion.

Morrison-Knudsen has prepared a detailed surface mining and reclamation permit application for LCRA (LCRA, 1984d). Detailed species lists for various planting zones are included in Appendix E. Wildlife benefits would be maximized through the introduction of wildlife food plots, fencing in selected locations to exclude cattle, interspersion of habitat types around water bodies and in woodland areas (e.g. post-oak clumps), and other features as indicated in Appendix E.

Overall, impacts on wildlife during operation of the mine would be adverse but localized and temporary. Wildlife usage of the area would be reestablished in parallel with succession of the field, pasture, and forest habitats. Most impacts to vegetation would be of short duration in any given area.

General Aquatic Impacts. Mining operations would ultimately disturb or destroy numerous small ponds, segments of Pin Oak Creek, Shaw Creek, Jones Creek, Owl Creek, Turkey Creek, and Cummins Creek, and portions of associated tributaries. Water zone and bank zone losses (excluding recovery by reclamation) in the immediate mining area would total 175 acres (LCRA, 1984b). In the mine area, up to 510 acres of riparian association could be affected (LCRA, 1984a).

Some concern exists for the potential for biological impacts from mine and power plant-related leaching and runoff of water soluble hydrocarbons, metals and radionuclides (USFWS, 1984; USFWS, 1985a; USFWS, 1985b). Water soluble components of lignite including hydrocarbons (principally polycyclic aromatic hydrocarbons) and heavy metals may leach from mining areas, stockpiles, conveyor lines, and reclaimed areas into surface waters and potentially harm fish and wildlife species (Hounslow, et al., 1977). Little is known about the aquatic fate of polycyclic aromatic hydrocarbons but it is thought that they will sorb strongly onto suspended particulates and biota, and that they are rapidly degraded in the water column. Those which accumulate in the sediment would be biodegraded or transformed by benthic organisms (Callahan, et al., 1979).

Runoff and leaching related to mining operations is described in Section 3.5.1, Surface Water Impacts, and in Section 3.5.2, Groundwater Impacts. Independent impact analyses included: 1) on-site inspection of the proposed project and a nearby power plant nearly identical in design; 2) literature review of leaching mechanisms involving the production of trace elements and radionuclides; 3) empirical and computer-assisted analyses on site-specific data projecting the potential for leaching at difference pH's; and 4) review of proposed water retention facilities at the mine and power plant site. These analyses indicated that groundwater contamination, runoff and leaching should be kept to acceptable water quality limits due to: 1) rapid reburial of overburden below oxidation zones; 2) timely replacement of topsoil and revegetation; 3) sedimentation through settling, and treatment if necessary, in runoff control structures at the mine; and 4) total retention of ash and coal pile runoff at the power plant. In addition, worst case runoff analyses for the mine and power plant indicate that instantaneous impacts from massive runoffs are unlikely. However, the analyses also indicated that more refined baseline data, and subsequent monitoring for radionuclides and other constituents of concern, as indicated above, may be appropriate.

While no individual source of water quality contamination has been explicitly identified which would adversely effect the aquatic or terrestrial environments, monitoring may be appropriate to alleviate concerns that cumulative impacts from the separate sources may occur over time. Identification of degrading water quality, should it occur, would allow for mitigation measures to be devised and implemented in a timely manner. More specific measures, such as monitoring by the Texas Parks and Wildlife Department for bioaccumulation of selenium, are discussed in the following sections.

Impacts to Ponds. Some existing ponds in the mine area, and a number of created ponds and ditches are to be used for runoff control. Water control plans include 37 ponds ranging in size from 6 to 2,013 acres during project life. Ponds controlling runoff from disturbed areas could serve to concentrate a variety of discharge materials (see Table 3-47, surface water section). These ponds are designed to treat mine discharge and other runoff by settling, and are likely to retain the concentrates during a 10-year, 24-hour storm. The potential exists for biomagnification of these materials (mainly heavy metals) in animals, especially waterfowl, utilizing these ponds unless efforts are made to restrict use. Periodic sampling of key ponds may be appropriate, with flocculation as necessary to remove contaminants. However, projected concentrations of runoff materials (e.g., arsenic, cadmium, chromium, copper, flouride, molybdenum, selenium, and uranium) from disturbed and undisturbed areas are not especially high. (See Tables 3-48 and 3-49, worst-case analysis of mining impacts on surface water). The present ponds receiving runoff from undisturbed land can be considered equivalent to settling ponds with respect to bioaccumulation of these materials. Reclamation plans for the ponds and reservoirs (LCRA, 1984a) seem appropriate and could help replace local aquatic habitat.

Impacts to Cummins Creek. A major impact resulting from mine activity would be upon Cummins Creek, especially the sections which pass directly through the mine area. Once the mining reaches Cummins Creek, in approximately 10+ yrs, the creek would be rerouted around active sites. Riparian habitat along the rerouted portion would cease to exist, although downstream portions should remain relatively unaffected except for occasional increased turbidity. Near the end of active mining, an end lake would be constructed. Filling of the end lake would be accomplished primarily by routing Cummin Creek into the lake. Flow of 0.5 cfs would be maintained to downstream portions of Cummins Creek while the lake fills in 10-15 years. Afterwards, the downstream portion would receive controlled overflow. Therefore, the downstream portion of Cummins Creek would cease to be intermittent and may actually become enhanced with respect to biota.

Reclamation. The reconstructed portions of Cummins Creek are expected to flow due to drainage of the surrounding area (approx. 5 square miles). This area, then, would have a fair chance of reclamation as long as the watershed area provides adequate water for revegetation. If not, the several miles of reconstructed Cummins Creek would have potentially extended dry periods during the fill up of the end lake. Established riparian vegetation may survive short dry periods but it is doubtful that the newly established vegetation could. Even if the 0.5 cfs flow was diverted just slightly downstream of the site from which the end is filled (Diversion Pond-9), the increased porosity of the streambed may keep the water from traveling the full course of the reconstructed channel, and downstream portions of the creek would have a reduced probability of successful reclamation. It may be appropriate to consider the Diversion Pond at the western end of the mine area (DP-9) for use as a supplemental source of water for the creek in the immediate mine area. The time for filling the end lake, however, may be increased. It assumed that after the end lake fills, most of the original watershed of Cummins Creek would feed only the creek so that it may resume its pre-mining flow.

The reconstructed channels of Cummins Creek are to have gravel bars and pools to provide habitat for benthos and other animals (e.g., fish fry). This would increase the likelihood of successful reclamation, but present physiographic conditions of the creek bottom are not known, so that placement or number of gravel bars and pools could be somewhat haphazard. During the time prior to rerouting of the creek, or even at the time of rerouting, it may be appropriate to sample the streambed for biota and for approximate riffle and pool numbers and sizes for eventual reestablishment of streambed structure. Consideration might also be given to: 1) maintenance of flow of water to the realigned channel of Cummins Creek after diversion but prior to development of the end lake; 2) the construction of small low water dams or weirs to promote water availability within the streambed; and 3) the establishment of a downstream monitoring program after reclamation of Cummins Creek to evaluate possible changes in water chemistry and possible effects on biota. Despite best efforts at restoration of riparian and aquatic habitat along Cummins Creek, it is probable that an irretrievable resource loss would occur.

Reclamation plans utimately call for an increase of surface water in the mine area from 150 acres to 980 acres, the majority of which is due to the end lake (845 acres). The quality of the surface waters are hypothetically going to increase (see Table 3-64a and LCRA, 1984a), again primarily due to the addition of the end lake. Ultimate reclamation, then, depends heavily upon the success of the establishment of end lake habitat. Although much of the potential shoreline is rather steep, the plan calls for some shallow area, primarily in the northern portion. This should provide for adequate waterfowl habitat and fish spawning sites. Leachate from exposed lignite seams should be minimal because of the proposed 4 ft barrier. Final water quality should be similar to that of Cummins Creek (LCRA, 1984b) and should support a variety of vegetation and wildlife.

Possible measures to incorporate into reclamation include:

1) monitoring of the various habitats (in particular riparian and woodland) in years 15, 30, and 45 to determine success of reclamation based on projected habitat units;

2) sampling of game fish and water fowl for possible bioaccumulation of heavy metals in ponds and end lake;

3) use of Diversion Pond 9 (DP-9) for supplemental water during end lake filling to avoid drying of unestablished stream banks;

4) maintenance of flow of water to the relined channel of Cummins Creek after diversion but prior to development of the end lake;

5) establishment of more detailed baseline data during the initial years of mining for streambed structure and biota of Cummins Creek before it is altered in the mine area; and

6) establishment of a downstream monitoring program after reclamation of Cummins Creek to evaluate possible changes in water chemistry and possible effects on biota.

Overland Conveyor

Construction of the overland conveyor and service road would result in removal of 122 acres of vegetation and associated habitat. Disruption of wildlife would be minor and short-term. Most of the vegetation along the route is either pastureland, grazingland or undeveloped. The fence along the conveyor and road would limit local migration of wildlife for the duration of the project. No critical or sensitive migration routes through this area have been identified from LCRA field surveys. On the local scale this impact would probably be moderate while on the regional scale the effect on wildlife migration would be unnoticeable. It is assumed that ultimately the fence and conveyor would be removed, in which case wildlife migration would revert to conditions without the project.

The conveyor and road would be constructed so as to minimize disruption of local drainage systems, thus minimizing disruption of aquatic communities. Only the upper reaches of intermittent streams would be crossed. Normal flow or gradient of the streams, as well as long-term water quality, would not be affected (Section 3.5). Culverts would be designed to eliminate the potential for flooding. Only a minimal and short-term impact would occur due to sedimentation during construction.

A short-term spill of ligntie into a surface water would be the worst case impact that could occur. The probability of such an occurrence is considered to be low and the potential impacts very minor.

Units 3 and 4 Construction and Operation

Construction and operation of Units 3 and 4 and related facilities would result in minimal disruption of vegetation and nearby wildlife since these units are being added to an existing power plant. Animals of lesser mobiliy and size may be directly eliminated by clearing operations at the 30 acre ash disposal sites.

Impact of Airborne Emissions on Wildlife. Concern has been expressed that power plant emissions of heavy metals could have measurable effects on wildlife (particularly, endangered species) in the drift from the stacks. Of particular concern are selenium emissions which, over 37 years of operation, could be bioaccumulated to toxic levels either in downwind lakes or in the terrestrial environment.

Other heavy metals of concern include arsenic, cadmium, lead and mercury. No information has been found on current selenium or other heavy metal levels in soil or sensitive species for areas downwind of the emission stacks.

An initial assessment of this impact was made to calculate the approximate concentration of selenium which could wash out from the atmosphere over the lifetime of the project. Based on Table 3-20, ground-level concentrations of selenium due to all FPP emissions would average 0.000071 micrograms per cubic meter at the site of maximum impact. Concentrations above the ground would be less, but for a conservative analysis, it was assumed that this concentration would continue upwards through a 1000-meter column of air. Thus the amount of airborne selenium above a square meter of land or water surface would average 0.071 micrograms in a typical year; this is the same as 7.1×10^{-8} grams per year. This value is considered a first-cut estimate of the amount of selenium mass which would wash out each year, per square meter of land or water surface.

For convenience, annual precipitation was taken as 1 meter per year. Assuming a density of 1 gram per cubic centimeter, this amount of precipitation would have a mass of 10^6 grams. Thus the average concentration of selenium in the rainfall would be 7.1×10^{-8} divided by 10^6 or approximately 7×10^{-14} grams selenium per grams water, or 7×10^{-8} parts per million by weight. This estimate is not meant to be precise, and indeed it is intended to overstate the impact; even so the calculation indicates that the amount of airborne selenium from FPP is very small when considered in terms of total mass.

USFWS (1985b) provided information indicating that selenium inputs to ecosystems of 0.02 ppm continued over a 10-year period have led to bioaccumulation to hazardous levels. The estimated inputs from all FPP sources would be 0.00000007 ppm for 37 years, or a total of .000003 ppm over the life of the project. Adjusting the data to an equivalent timeframe, the FPP emissions contribute the same mass in 37 years as would occur from a 10-year emission containing 0.0000002 ppm.

Based on the above analysis, the total airborne selenium input from all FPP sources is 10^{-5} (one one-hundred thousandth) of the level which is indicated as excessive. Even given various qualifications and uncertainties which might pertain to the calculation, it appears that the FPP emissions are very small compared to those known to be unacceptable, and that there is a safety factor of several orders of magnitude in this conclusion. On this basis, the potential impacts from FPP's airborne selenium do not appear to be of such a magnitude as to pose a threat, by and of themselves, or to have an effect on endangered species downwind of the project.

Not withstanding the results of calculated predictions presented above, selenium in runoff or possibly air emissions from a lignite-fired power plant in northern Texas has resulted in high concentrations in the muscle tissue and livers of bass in Martin Creek Lake (Palafox, 1985, and Cain, 1985) and adverse effects including fish mortality have occured under similar conditions. Levels of concern have been noted as recently as the fall of 1984. The Texas Parks and Wildlife Department has initiated a sampling program of cooling reservoirs for all lignite-fired power plants in the state.

EPA recognizes that the cumulative effects of air and water-borne sources, (from FPP and other existing and proposed power plants in the area), added to the ability of selenium to accumulate to toxic concentrations in trophic levels below fish, make it difficult to accurately project impacts. Since the Houston toad (Bufo houstonensis), an endangered species, occurs in this area, it may be appropriate to monitor the effects of these power plant emissions over the life of the project. This could be accomplished by bioassays for current conditions and at least annually for a closely related species of toad that is not endangered in area ponds and lakes. This bioassay should include an assessment of mortality, growth, and possible embryonic malformations in eggs and larvae. This monitoring effort should be coordinated with the aquatic monitoring of fish as described below.

This TPWD comprehensive sampling program includes establishment of background conditions in three species of fish, followed by annual monitoring of large mouth bass tissue. When levels exceed 4 mg/kg in the fish livers, more intensive monitoring is conducted. For Cedar Creek Reservoir, background samples have already been collected but have yet to be analyzed. This will establish current conditions, and cooperation by LCRA with this program should be adequate for this lake. Monitoring of other area bodies of water for selenium levels or other heavy metals would be in addition to this effort and could be conducted by a third party. In addition, effects on vegetation in downwind areas also should be monitored and include soil sampling intensively near the plant and less intensively beyond about 2 miles.

Impacts from Wastewater/Cooling Water Discharges. Slightly elevated temperatures (several degrees) would occur in the pond from the operation of units 3 and 4. Fish productivity (reflective of general pond productivity) is not hindered and may even become enhanced with increased water temperatures. The temperature increase is not likely to exceed maximum tolerable spawning temperatures for fish species of interest in shallow waters. Discharge of water with slightly elevated temperatures into Cedar Creek is not anticipated to be detrimental to fish and other wildlife downstream, which is also true for the projected increase in rate of discharge during periods of reduced water use at the power plant. No other impacts from permitted discharges are anticipated. (See also Section 3.5.1)

In the worst case storm runoff analysis for the power plant, constituents of concern included cadmium, lead, selenium and mercury. No impact to aquatic life in the Colorado River was projected from a major rainstorm (one which would occur once in one hundred years).

Airborne Emissions Impacts to Vegetation. Vegetation in the vicinity of the power plant would be subject to slightly increased concentrations of some air contaminants. Based on present sampling data, the predicted cummulative (Units 1 through 4) concentrations of SO_2 (Section 3.3) are far below the injury thresholds for sensitive plants of 1300 ug/m^3 for 4 and 8 to 24 hours, respectively (Shurtleff, et al., 1972). Vegetation in the project area is not overly sensitive to SO_2 and NO_2 compared to more sensitive vegetation such as soybeans and alfalfa.

EPA (1976b) indicates that sensitive vegetation such as alfalfa, peas, oats, etc., can tolerate exposures to SO_2 up to 2,489 ug/^{3} for two hours or 917 ug/m^3 for four hours. Linzon (1978) found similar injury threshold doses of 1,820 ug/m^3 and 468 ug/m^3 for SO_2 exposures of one hour and eight hours, respectively, required to cause acute injury to native vegetation. However, he also reported mild foliar symptoms in forest ecosystems during average SO_2 concentrations of 21-44 ug/m^3 over entire growing seasons. This concentration range over the growing season is much more than the maximum annual concentration of 12 ug/m^3 predicted for the total emissions from the existing and proposed new units. Since predicted concentrations are far below reported injury threshold doses, SO_2 concentrations resulting from the power plant should have no significant impact on adjacent plant communities.

The maximum annual ambient concentrations of NO_2 are projected to be 8 ug/m^3, far less than the NAAQS primary and secondary standard of 100 ug/m^3 as an annual average. The NO_2 concentration must be an order of magnitude greater than the NAAQS maximum during continuous exposure before plants are impacted (Hindawi, 1970).

Sulfur dioxide and nitrous oxides from coal-fired power plants may contribute to acid rain, which is thought to be detrimental to plant growth. The potential impacts of acid rain are discussed in Section 3.9, Cumulative Impacts.

Combined Effects. Construction and operation of the conveyor, the mine, and power plant Units 3 and 4 (including ash and sludge disposal area) would impact directly about 10,220 acres of woodland, pasture, cropland, and aquatic habitats. About 36 percent is woodland and aquatic habitat. Disturbance would be staggered over 35 years with 2 additional years devoted to continuing reclamation and cleanup. During the life of the project, significant portions of the project area would be under direct impact of mining and construction activity, resulting in an overall loss of wildlife due to habitat destruction. Reclamation efforts would result in rapid replacement of pasture habitat but forest restoration would only occur after many years. Under the reclamation plans, the approximate current acreages of various habitat types would be restored with an exception being an increase of surface water at the expense of other terrestrial habitats.

Although it would probably take several decades for individual trees to reach the stage of maturity of those presently on site, trees would be planted as mining progresses, and thus would be spread out over the life of the project. By the end of the project, trees in the first areas reclaimed would be fairly mature, and the overall appearance of reclaimed areas would be a gradient from the earliest to most recent. As succession on the reclaimed areas proceeds through various developmental stages toward a climax community, wildlife species diversity within these areas would undergo corresponding change.

The effect of the project under this scenario would be an initial overall reduction in the density and diversity of wildlife species. However, as succession of the reclaimed forest areas advances, the diversity of wildlife species would increase. The wildlife diversity and carrying capacities of the reclaimed forests would reach a similar successional stage to existing forests.

A systematic monitoring program may be appropriate to better assess background levels, to determine trends during operations, and to determine any need for increased environmental controls.

3.8 ARCHEOLOGICAL AND HISTORIC RESOURCES

Existing Conditions

Numerous and significant prehistoric (aboriginal) and historic resources occur in the project area and region. The resources, such as 10,000 year old aboriginal hunting camps, stone tool production sites, Indian trails (La Bahia Road) and other early traces and roads, evidence of encounters of settlers with Comanche Indians by grave or massacre site, first log cabins of original settlers and their later houses and farmsteads, developments by later historic period arrivals or offspring of early settlers, towns, churches, cemeteries, saloons, stores, and evidences of early schools for education of the young, comprise a Historic District determined to be eligible for the National Register of Historic Places. The resources within and throughout the project area are identified as the Fayette Power/Rabbs-Cummins Creek Mine Historic District.

This District includes a geographic area which includes the communities directly affected -- Ledbetter, Nechanitz and Waldeck; the mine, and mine ancillary facilities areas (generally shown in survey reports as "buffer"); the proposed lignite conveyor corridor, and sites in the ash disposal area. In the future, resources in the proposed Baylor Creek Reservoir area, as well as additional transmission line corridors, are expected to be added to this District. These conclusions are in concurrence with determinations of the Texas State Historic Preservation Officer. See letter in Appendix F. EPA is in the process of submitting a concurrence determination of eligibility to the Keeper of the National Register.

Some present residents and descendants of early settlers in the area are possibly unaware of the information they and their resources may provide to history about the permanent settlement of the local area, the Republic and the State of Texas, as well as the development of a rather special and unique culture known as that of the German-Texan. For example; little is known about the adaptations of the European heritage and innovations that were made by the immigrants to this particular natural/ecological region. While German-settled cities are fairly well represented in history, this district is unique for the rural ethnic heritage it contains in its dispersed farmsteads and communities. While some farmsteads are in a pristine setting, many are valuable in that they include structures with an original settlement or early structure at their core, and thus provide a history of modifications in life-ways over time; yet retaining the German Texan heritage. The contemporary represents a continuation of the historic German-Texan settlement life. Fayette County and adjacent counties are named by the Texas Historical Commission as the eastern area of the German-Texan Study Unit in the Resource Protection Planning Process For Texas, developed in 1982. Further, the area has been declared most endangered of the German-Texan settlement areas by the THC and workshop members, archeologists, historians, architects, and scientists, during the plan development. (THC, 1982).

Land in the area contains significant information that may help identify whether prehistoric men were of a distinct culture adapted to the zone, or occurred here on the fringes of other surrounding cultures, the East Texas, Coastal Texas and Central Texas cultures.

Some surveyors hypothesize the area was used by aboriginals of the three cultures for a trading and social interaction area. Information from the 135 prehistoric sites now known within the district have potential to define a more permanent aboriginal culture and determine their settlement patterns and lifeways specific to this region.

The resources in the district have been identified by surveys conducted by Texas Archeological Survey, contract group within the University of Texas Archeological Research Laboratory, under contract to LCRA. Appendix F contains a list of reports from investigations conducted on the present project area, the initial power plant area and transmission lines, as well as additional pertinent survey reports. A statement of survey methodology and of limitations on the surveys is included in Appendix F. Approximately 2100 acres are unsurveyed in the mine and proposed conveyor area.

The prehistoric aboriginal life is evidenced by remains of fire hearths, flint debris, stone tools, mussell shell, charcoal, pottery and middens. Prehistoric time sequences are estimated and summarized as follows: Paleoindian. Pre-10,000 to 8,000 Before the Present (B.P.) (or 8,000 to 6,000 B.C.). Early large lanceolate projectile point types indicate that these people occupied this area subsisting as hunters and gatherers. Archaic (8500 to 1250 B.P.). Archaic hunters and gatherers were completely dependent on the variable water, game and edible factors. Tool kits included contracting and expanding stem dart points, food processing tools such as manos and metates, and auxiliary implements. People of this period possibly represent a more complete adaptation to their environment, compared to the specialized Paleoindian groups. Late Prehistoric (1250 B.P. to European Contact). Profound changes took place during this period; for example, the bow and arrow replaced the dart thrower, and pottery appeared.

One hundred thirty five prehistoric sites of lithic scatters, lithic/burned rock scatters, and lithic quarry sites occur in the area, including the more remote uplands. Site types include hunting camps and lithic procurement for stone tools; notably missing are burial sites. Many sites listed in surveys initially as light scatters without features have with testing produced features and diagnostic artifacts. All sites to date are based on surface exposure. The consultant archeologists have hypothesized that the Cummins Creek basin sites were oriented toward exploitation of accessible lithic (stone) materials (for producing tools, etc.), while Rabbs Creek basin habitation was for more generalized domestic functions. Water supply reliability is believed to have differed since Jones and Owl Creeks (of Rabbs Creek basin) contain pooling by spring water even during droughts, while Cummins Creek is believed to have been intermittent over time. Occupations along Cummins Creek may have been of shorter duration or scheduled on a seasonal basis. Datable tools show occupations of the Paleo, Late Paleoindian, the Early, Middle and Late Archaic, and the Late Prehistoric time periods.

Historic Period. Current lifeways are a continuation of more than one hundred and fifty years by a distinct group, the German-Texans, with beginnings by two immigrant waves: in the 1820's and 1830's before the Texas Revolution and between 1836, when Texas joined the United States, and just before the Civil War. German-Texan elements in the historic district range from the early 1832 Biegel settlement (the power plant, ash disposal, conveyor area) to the later and present farmsteads and towns, including Nechanitz, Waldeck and Ledbetter (each considered eligible as a historic district on its own merits). The "historic" community has its own specific nature, association, and feel, predicated on settlement history, ecology, and adaptation pattern. The German-Texan is described as one group within which much of the rural heritage has survived intact and can be conserved (THC, 1982). There are unique groups of German-Texans, unique architecture, and unique artisan District sites.

Much of the Historic Period (350 years Before the Present to Present time) is represented by farmsteads, towns, churches, stores, saloons, a hotel, and remmants of roads, schools and water supplies. Prior to the establishment of a substantial and industrious German-Texan community beginning in 1831, historic settlement began with colonization on land initially granted from the Mexican Government through Stephen F. Austin in the 1820's and 1830's. The earliest settlers, often land speculators, were Anglo-Americans from the South, some of whom brought Negro slaves.

Earlier, 18th century European explorers' first contacts were with aboriginal bands of Yojuane, Apache, and coastal groups. Migratory bands of Tonkawa, Caddo, and Coahuiltecan Indians may have passed through the area. Indians living in the region were eventually rounded up and confined to mission compounds. However, Comanche raids continued from time to time, until after the Texas Republic.

The sixty-nine historic period structures and sites recorded within the District and this proposed permit action area begin with remnants of the second German immigrant settlement in Texas, initiated in 1832 by Joseph Biegel. The Biegel Cemetery; another 3-burial cemetery believed to be remains of the Malcik Family settlers in the Biegel league; a recently discovered very old farmstead across stream from the Malcik cemetery; and the Harlfinger-Schumacher House and site, a 19th Century German folk structure built in 1880 are all, designated contributing members of the District occurring in the 412-acre ash disposal area. Other recorded but unrelocatable resources include two sugar cane processing sites.

Early roads through the mine, conveyor, and plant areas include La Bahia Road, Wilbarger Trace, Gotcher (Goacher) Trace, Rabbs Road and La Grange Road. La Bahia Road, originally an Indian trail, was adopted by the Spanish and used by Alonso de Leon by 1690 (Webb, 1952); it was known as Opelousas Road during the 1800s when used heavily as a cattle trail. Gotcher Trace, which opened in 1828, was also the Washington-on-the-Brazos to Bastrop Road.

The dispersed German-Texan communities include; Nechanitz, Waldeck, and Bell, developed during the 1850s and 1860s within the mine and conveyor effect areas. Land grants were made later in the 1840s under the auspices of the Republic of Texas to Anglos of the South. Settlement began largely when German immigrants purchased land and began to farm the area.

Nechanitz is described in Figure 3-29, a school essay by a fifth-generation German-Texan of this area (Bramblett, 1982). Also demonstrated are some of the cultural value, feel and associations within the area, including the Waldeck Community. Site 41FY401, the Wenzel Matejowsky farmstead is considered eligible for the National Register, meeting several criteria on its individual merits. This farmstead is one of numerous farmsteads in the District which has remained within one family for more than one hundred years; it is designated as a Texas Heritage Farm. The Matejowsky log cabin was located near the 1867 house and original store. The site was a Wells Fargo stop. The present house constructed in 1867 is in excellent condition and distinctly reflects the German heritage. Long established traditions related to the area's natural environment and community are still carried on by the family. Site 41FY408 is the home site of Mr. Joe Matejowsky, who owns Nechanitz store. The large, well built pyramidal house was constructed in 1913 by Mr. Petzold, who is considered a master craftsman of the area. Site 41FY406, is the site of two school buildings, the first was built in the late 19th Century for the Nechanitz Common School District; the second was constructed in 1925, the well drilled then still remains. All the historic sites recorded in Nechanitz are considered to be eligible for the Register as a district.

Waldeck which is somewhat surrounded by the proposed project, is also eligible as a district. It contains numerous 19th Century homes and structures preserved in an almost unspoiled community setting. The town appears to have grown up around the Aschen Store. Recorded and unrecorded sites including the store, the Lutheran church, Waldeck cemetery, the 1902 Sons of Hermann Hall, homes are significant and are contributing members of the Fayette Power/Rabbs-Cummins Creek Historic District. Figure 3-30 indicates the known structures community layout. Some members have moved due to mine and road relocation activities proposed, but all the structures are in place. Waldeck had some features which Nechanitz did not have including: a saloon, lodge hall, blacksmith shop, cemetery and church.

The Bell Settlement information is very sketchy and likely will never be well placed in history, unless information is obtained before this project takes place. A connection may exist between the Aschen store, Bell School, Bell cemetery, as well as 41FY278, a house with an upper floor that served as Bell School classroom for a while.

The town of Ledbetter (41FY301) was platted along the new railroad and dedicated in 1870. It prospered as a cotton belt farm area. By 1902, it included; four general stores, two lumberyards, two drug stores, two saloons, a blacksmith shop, and two physicians. (Lotto, 1902). Part of the hotel used by railroad crew and passengers alike has been adapted for a home; the Ledbetter store is very much in business. Currently unrecorded are structures possibly associated with black

Figure 3-29

NECHANITZ

by

Jamie Bramblett

Throughout this big state of Texas are many, many towns that have many, many German backgrounds.

One of these towns lies in the ourskirts of Fayette County. This town is about eleven miles north of La Grange, the county seat. It is build around an old country store where all of the residents come at night to play dominoes, drink a nice cold beer, swap stories, and just have alot of fun. I have been lucky enough to be a part of this town. I lived there for six years and all of my family roots came from this town.

As of 1982, the population of Nechanitz was three. These three people happen to be my grandmother, great uncle, and great aunt. But believe it or not, this town used to be a good sized, thriving town.

Nechanitz was officially named in 1873 by Honorable Wenzel Matejowsky. Mr. Matejowsky was my great, great, grandfather. He was an immigrant from Nechanitz, Bohemia. His father was mayor of that town. His brother later became mayor of that town and his other brother was the equivalent of district judge in Progue, Bohemia.

Wenzel Matejowsky came to the U.S. via Galveston in 1850. After he moved to Bastrop, he married Miss Christina Dietrich. They soon moved to Long Prairie which would later become Nechanitz. He farmed until 1867 when he went into the merchantile business.

For many years he was a staunch republican and an able republican leader. In 1886 he was elected representative to the Twentieth Legislature in the new capital building. He was also the first person to play a piano in the new Capitol Building.

Wenzel Matejowsky was a very popular figure in the area throughout his life. He and his wife had 14 children. The Honorable Wenzel Matejowsky died in 1904. Two of his sons, Paul and Charles remained in the marchantile business. Upon Mr. Wenzels death, the two sons took over the store and ran it until 1927 when the partnership dissolved and Charles became sole owner of the store.

Nechanitz was officially named by Wenzel Matejowsky in 1873 when it became a United States Post Office. The post office was located in Nechanitz until 1954. It made history for being the only post office to be run in the same family for over fifty years. This was in fact run for seventy-three, a national record. It operated until April of 1954 when the United Postal Service closed it. During the last seven years of its operations, it was run by Charles' son, Joe Matejowsky, which runs the store and is one of the three people living there today.

Mr. Matejoswky build several gins in his time, and the last one was built by Charles' son-in-law, Herman Hannes. Herman is related to Mathew Hannes who is in La Grange High School.

One building, which is not standing today was an old elementary school which was used from 1850 to 1945. It was then torn down and moved to the new district of Round Top, Carmine.

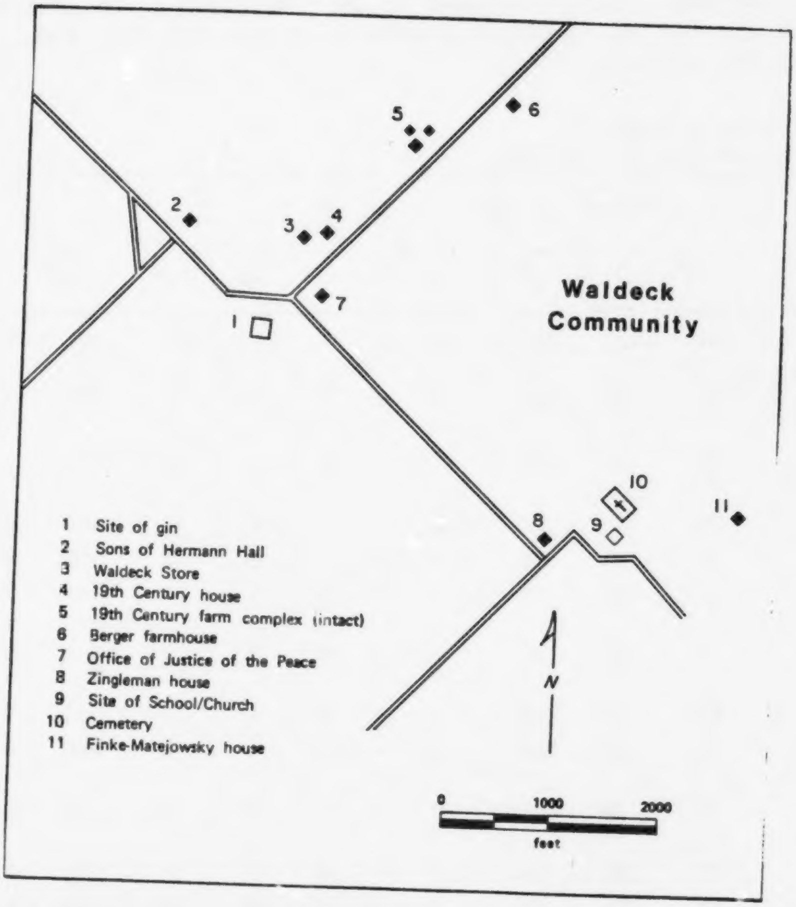
Two buildings still stand just like they did in 1873. The home of Wenzel Matejoswky, which my grandmother, Ester Matejowsky, lives in today and the home of Charles Matejowsky which is being lived in by Joe Matejowsky who still operates the store. The original store stood for over 125 years until it burned down because of faulty wiring in 1971. It was a famous landmark and has its picture in the Museum.

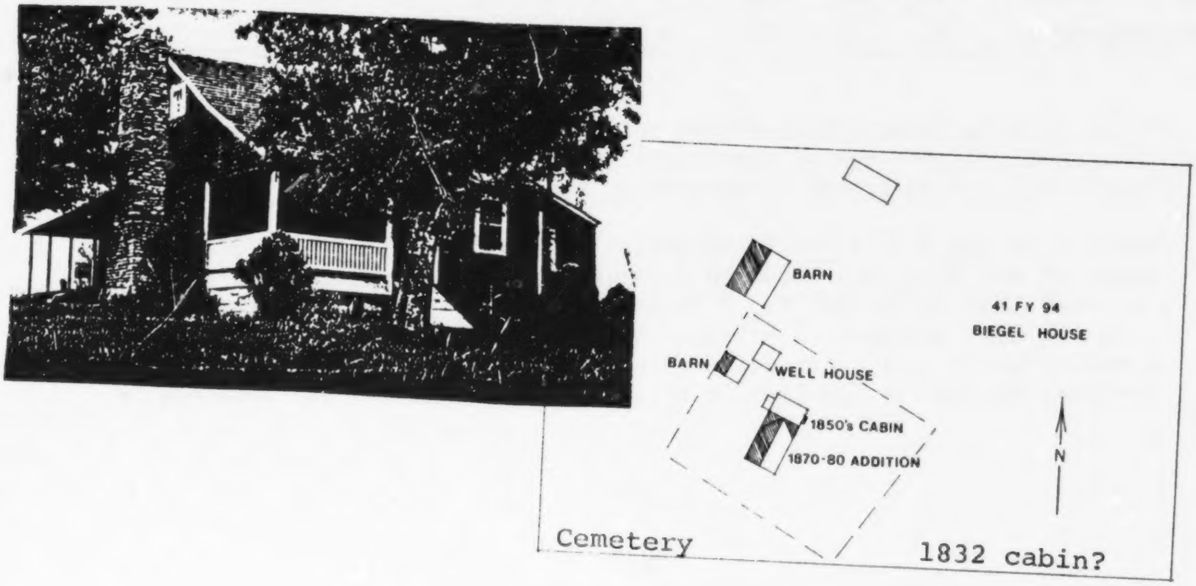
Everything is about the same as it was in 1900. We all go to the Waldeck church just like Wenzel did and everyone's sons still live in the area. Yes, there are other places like Nachanitz but none quite as special to me. It is just as beautiful as 1900 because of the families raising bluebonnets for many years. The last bluebonnet crop was harvested so recent that I had to help harvest it. Although, you can still see a field of bluebonnets with no patches of dirt or grass anywhere in the springtime. The field has had many writeups about it in all of the major newspapers in Houston and Austin. Just another one of the things that makes this town so special.

Nechanitz is a great town and I'm proud to be part of it. If you have a free hour sometime, go out there and stop by. Just like 100 years ago, you'll see people playing dominoes, people sitting on their front porch, and out working in the fields. It's like a town trapped in time. It's a town that will never be forgotten, by me or anyone that sees it. It's a wonderful town.

Figure 3-30

Examples of Settlement Patterns
in the Project Area


Waldeck Community
1 Site of gin
2 Sons of Hermann Hall
3 Waldeck Store
4 19th Century house
5 19th Century farm complex (intact)
6 Berger farmhouse
7 Office of Justice of the Peace
8 Zingleman house
9 Site of School/Church
10 Cemetery
11 Finke-Matejowsky house
N
0
1000
2000
feet


BARN
41 FY 94
BIEGEL HOUSE
BARN
WELL HOUSE
1850's CABIN
1870-80 ADDITION
N
Cemetery
1832 cabin?

residents who originally came to the area as slaves on the few Anglo farms.

Many significant historic dispersed farmsteads occur. The following Table 3-65 indicates those included in the 1860 census, Productions of Agriculture and tax rolls within a portion of the District area. (From Nightengale and Jackson, 1983).

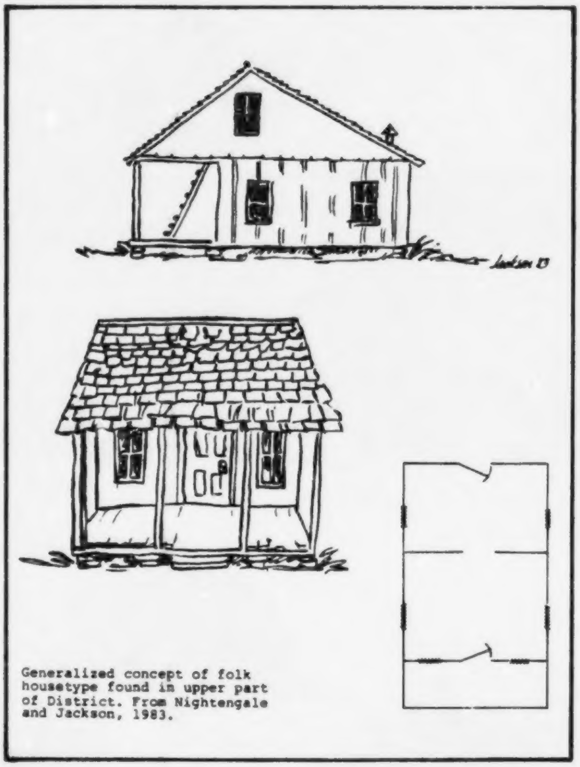
Table 3-65
Cummins Creek Area Farms in 1860

	ACRES												
NAME	Imp.	Unimp	Cash value farm	Horses	Milch cows	Oxen	Other cattle	Swine	Value livestock	Bu. wheat	Bu. rye	Bu. corn	Cotton 400 lb. bls.
John Fink (Menklenburg)	20	157	500	4	4	2	18	40	300	0	0	24	1
Valentine Storch [illegible]	10	90	400	3	8	2	8	0	105	0	0	20	1
Fredrich Retche (Prussian)	15	80	400	1	2	2	0	4	105	0	0	15	1
John C. Moss	25	379	1000	2	10	2	8	13	330	0	0	75	2
John Gonder	9	40	300	1	8	2	6	3	150	0	0	0	0
Henry Behrens (Prussian)	20	80	500	2	3	0	3	8	125	0	25	20	0
John Behrens (Prussian)	0	100	0	1	3	0	3	0	100	0	0	0	0
Henry Voit	12	40	250	1	6	2	4	7	125	0	0	0	0
John Jungermann (Prussian)	12	38	300	1	4	2	4	4	160	0	6	50	1
Carl Kruse (Hanover)	8	92	325	3	0	4	0	5	250	0	0	150	4
Reinhardt Tofele	12	200	800	1	15	4	11	21	350	0	0	0	2
Geo. W. Thompson	250	250	750	9	13	6	10	25	570	0	0	1000	24
John Stallbraun	10	90	325	4	12	10	13	30	700	0	0	0	1

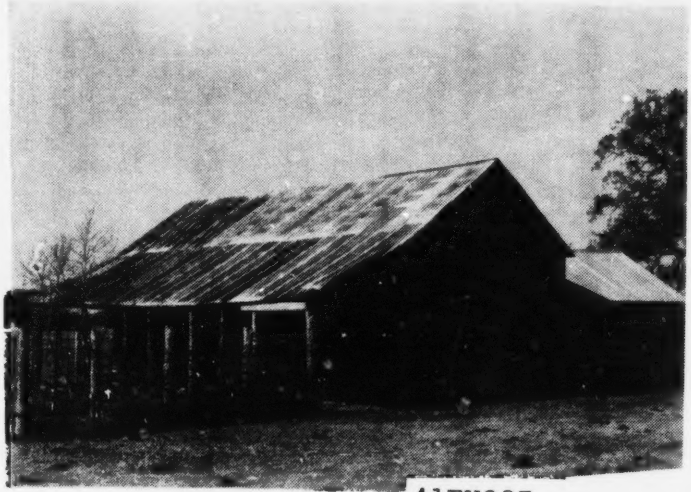
Figure 3-31 includes a generalized concept of settler housetype and actual structures with diagram of modifications in German-Texan tradition. Figure 3-32 includes some farmsteads in the District.

There is evidence of a least two master craftsmen of the area. Several remaining buildings are known to be constructed by Mr. Petzold during the 1800's and early 1900's. A Baromet (toy with moveable figures) carved by Emil Schumann in Waldeck in the late 1800's is displayed in the Winedale Museum. It is expected many innovative items and procedures developed by settler families in this area are unrecorded for descendants.

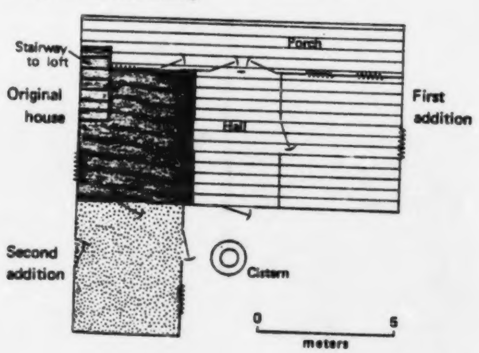
Figure 3-31
Conceptual & Actual Structures
Mine & Ancillary Facilities Area

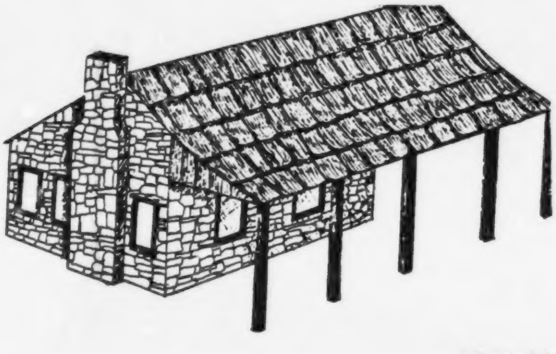


Generalized concept of folk housetype found in upper part of District. From Nightengale and Jackson, 1983.



41FY387


Approximate scale drawing
Stairway to loft
Porch
Original house
Hall
First addition
Second addition
Cistern
0
5
meters



41FY403

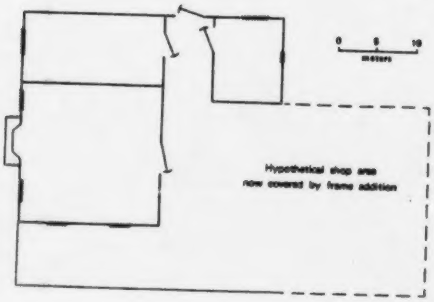
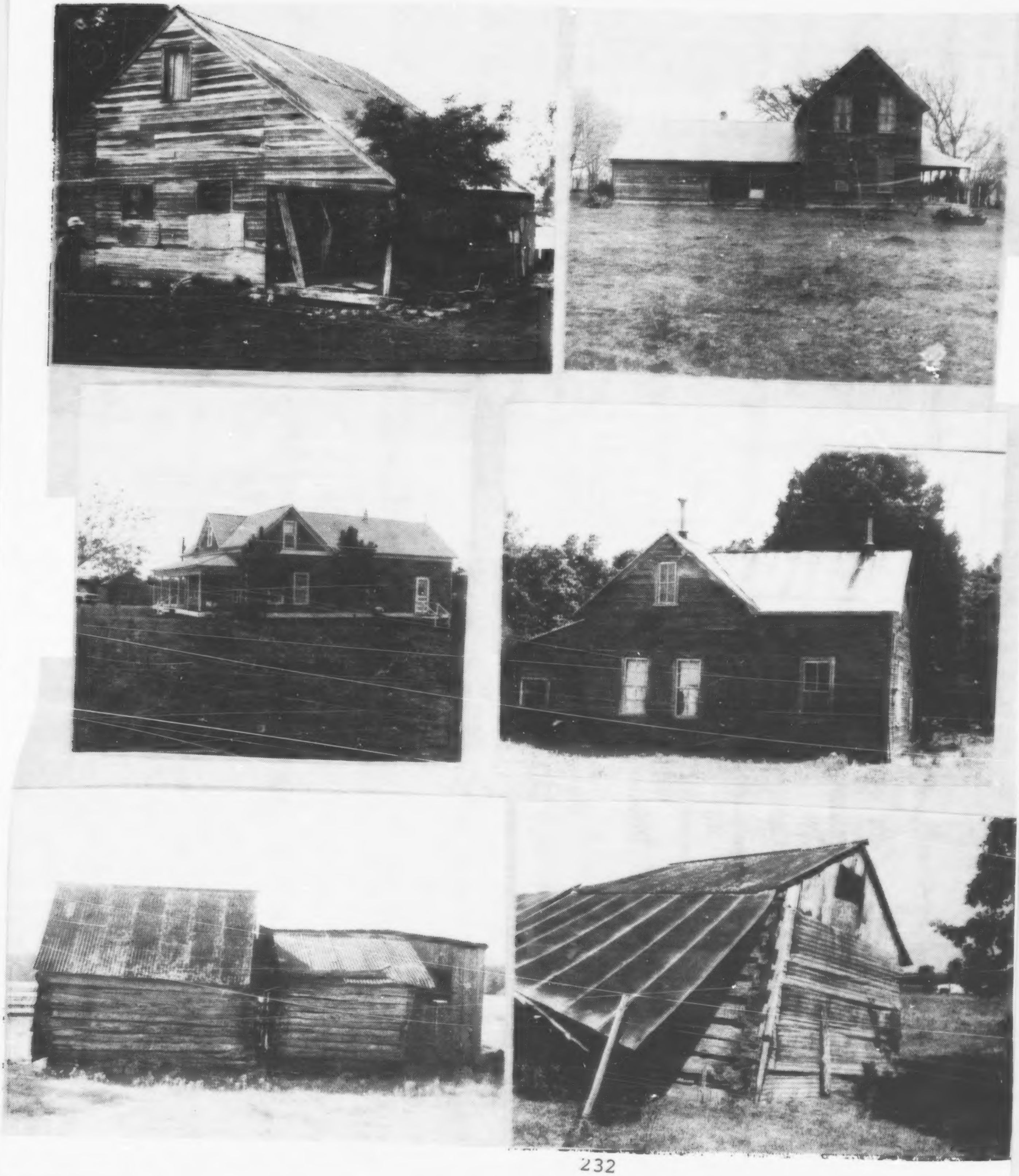

0
5
10
meters
Hypothetical shop area now covered by frame addition

Figure 3-32
Farmsteads in Mine, Ancillary
Facilities Area



Impacts of Project Alternatives; Responsibility and Measures for Protection

The regulations of the National Historic Preservation Act provide criteria to be used to determine effect from a federally licensed undertaking on a National Register eligible property. Effect is to be measured in the context of the historical, archeological or cultural significance of the property. The project has an effect when any condition of the undertaking causes or may cause a change in quality of the significant characteristics. An effect occurs if the project changes integrity of location, design, setting, materials, workmanship, feeling or association. Effects may be direct or indirect.

Adverse effect occurs under the following conditions (but is not limited to these):

1. Destruction or alteration to all of part of a property;
2. Isolation from or alteration of the propertys' (sites') surrounding environment;
3. Introduction of visual, audible or atmospheric elements that are out of character or alter its setting;
4. Neglect of a property resulting in its deterioration or destruction;
5. Transfer of property without adequate conditions for preservation, maintenance or use.

Regarding impacts the Texas Historical Commission (1982) stated: "The geographical extent of impact of any resource area cannot be defined or measured in terms of the cubic feet of space occupied by cultural remains. Analysis and interpretation of the data contained in archeological resources requires examination of their total physical and ecological context. Any disruption of this context reduces the amount of, and may completely destroy recoverable information about past human existence, constituting an irretrievable loss for scientific study."

Impacts to Cultural Resources from the Proposed Project

Construction of Fayette Power Plant Unit 3, and part of the foundation of Unit 4 is underway and has already adversely affected any archeological resources or standing structures that occurred on the specific site. This construction has contributed to the overall loss of the historic Biegel Settlement which dates back to 1832 and the ethnic "feel" associated with it. The 1975 survey by TAS identified the Joseph Biegel house and recommended nomination to the National Register of Historic Places based largely on architectural significance, although the site would have been eligible based on several criteria. However, the house was not nominated to or determined eligible for the Register, nor were appropriate scaled drawings and recordation submitted to the Historic American Buildings Survey. The house structure was donated to and removed by the University of Texas System staff to their Winedale Museum. The house is not open to or in view of the public, but is used by the staff. No on-site archeological/historical information was obtained regarding the very early settler lifeways and adaptations to their new land; only legal/deed record information remains. (However, some valuable oral history was obtained during that survey on another later historic site within the settlement before it was bulldozed). The site was lost.

The ash disposal area part of the present proposal has been purchased by LCRA so that all relocation of any families has taken place. Resources which have been destroyed by land clearing and modification are: site 41FY88, a rock cairn with unmarked headstone and 41FY89 which is believed to be remains of a sugar cane processing site consisting of placed flat field stones and adjacent well; and prehistoric site 41FY169 believed to be a stone tool manufacture station. Two other stone tool production sites occur: 41FY308 which is only partly lost due to the railroad construction and 41FY307 which will likely be affected by earth moving and packing of the surface. The area is to be reinvestigated for possible prehistoric remains at depth. Another prehistoric site discovered February 1985 would be affected similarly. Two cemeteries occur; the Malcik cemetery would be impacted by earth moving, packing of clay lining, and ash waste, as it occurs at the lower elevation within the area. Also, a recently observed but still unidentified and unrecorded historic farmstead site across the creek from the cemetery would be affected the same. Both are presently becoming endangered by increasing erosion due to stream siltation induced hydrologic changes. Harlfinger-Schumacher House, site 41FY309, is a remnant of the Biegel settlement and is a contributing member of the Historic District; it still contains historic information but will be further disassociated from its cultural value by the waste disposal activities.

Contruction and operation of the mine and its ancillary facilities such as any transmission lines, haul roads, and wastewater treatment ponds (shown as buffer zone in some reports) will involve all of the criteria of adverse effect on cultural resources. Included are: demolition or removal of standing structures and destruction or alteration of subsurface (archeological) properties at such as prehistoric camp sites. In cases where a structure or a site such as a cemetery may be mined around, isolation from or disturbance of the setting feeling, and natural environment will occur. The introduction of elements out of character with the sites and their context will occur including; noise, traffic, and bisection of the countryside by the transportation facilities. Some significant loss has occurred already; for example with pending mining, the Drawe House was moved after survey designation as significant for its architecture. No architectural data is available in its settlement place and context. The ethnic cultural value and association between the historic sites in the mine area will be lost. Of the 194 sites that occur in the mine area, most will be affected directly; all will be affected indirectly. Table 3-66 lists currently known historic and prehistoric sites in the mine affected area of the project and notation of projected impacts.

Regarding impacts on the historic communities in the District- The Biegel Settlement remnants sites would be graded, packed with clay, buried by ash or isolated. It appears the Bell Settlement area would be mined.

TABLE 3-66
CURRENTLY RECORDED HISTORIC PERIOD SITES WITHIN FAYETTE POWER/RABBS-CUMMINS CREEK MINE HISTORIC DISTRICT AND PROJECT EFFECTS **

Site	Type	Site Name/or Owner	Builder/Year Construction	Project Effect
41 FY 272	19th Century Farmstead Complex Home of Carl Kruse, "Oldenburger Schoolmaster"	Albers/Behrens		Mined
41 FY 273	Burials	Bell Cemetery	Early as?	Mined should (avoid)
41 FY 274	Traditional 19th Century Farmstead	Hays	1920?	Mine & T5
41 FY 275	Vernacular farmhouse	Hays	1920's?	Mined
41 FY 276	"Double Shotgun" House/Farmstead	Mueller	1900?	Mined
41 FY 277	Vernacular farmhouse	Muehler	Late 1800's?	Mined
41 FY 278	"Homestead" style-additions 1915 Upper floor-Bell School Classroom	Pietsch	Petzold/1900	Mined
41 FY 279	Log cabin ruins	Wendler		Mined
41 FY 280	House 80 years old on log cabin site	Wendler	about 1900	Mined
41 FY 281	Marker - Alexander Grave or Massacre Site	Alexander Memorial		Mined
41 FY 282	19th Century Farmhouse	Stuermer	Before 1907	
41 FY 283	Burials-Family Cemetery to 1892	Moss	1892	
41 FY 284	Cabin and farmstead	Moss	Mid 1800's	Unknown
41 FY 285	House and Concrete well	Stuermer	Early 1900's	Unknown
41 FY 286	Victorian-Moved in?	Fuller	Early 1900's	Ancillary Facilities

41 FY 287	Farmstead	Radentz Farm		
41 FY 288	Site of Cistern	Boehm		Mined
41 FY 290	House moved in - Family property since late 1800	Hughes	Early 1900's	Ancillary Facilities
41 FY 291	Vertical board house	Albers	1927	Unknown
41 FY 292	Farmhouse	Ebner		Mined
41 FY 293	Barn and Foundation, Saw mill site	Matejowsky/Schultz	Mid 1800's	Unknown
41 FY 294	Clapboard house	Wehrmeister House	Petzold/Late 1800's	Mined
41 FY 295	Traditional Anglo house		Late 1800's	Ancillary Facilities
41 FY 296a	Log Storage Bin	Solomon		Ancillary Facilities
41 FY 296b	Late 19th Century Homestead	Solomon	Late 1800's	
41 FY 297	19th Century Farmstead	Bernhausen-Koopman		Topsoil Storage, Road Construction
41 FY 298	Hickey-Wendler House	Hickey	1927?	Ancillary Facilities
41 FY 299	Clapboard House	Hughes	Early 1900's	Ancillary Facilities
41 FY 300	Pre-1900 Dog Trot	Drawe	1884	Mined
41 FY 301	Town of Ledbetter - Platted 1870			Mining/?
41 FY 302	Late Victorian Cottage	Stephan	John Moss	Unknown
41 FY 303	Bungalow	Weise	Constructed 1909 Renovated-Petzold in 1936	Mined

41 FY 304	Story and a half farmhouse	Wendler	Early 1900's	Unknown
41 FY 305	Foundation	Albers	?	Mined
41 FY 383	Nechanitz Rent House Site - Turn of Century	Matejowsky	1900	Sedimentation Pond-3
41 FY 384	Farmstead - Southern Pyramidal House	Withers	1920?	S Pond-4
41 FY 385	Farmstead and log barn	Withers	1920?	
41 FY 386	German Folk House	Freeman	?	Relocation FM 1291
41 FY 387*	German Folk House	Krause	?	Ancillary Facilities/ Road Relocation
41 FY 388*	Bernhausen-Zieger House German Folk House	Bernhausen	Robert Zieger 1907	
41 FY 389	Cemetery - Waldeck			Conveyor
41 FY 390	Farmstead	Gallip	Late 1800's	Unknown
41 FY 391	Brand Farmhouse	Brand	Late 1800's	Unknown
41 FY 392	Berger House	Berger	Late 1800's Core	Unknown
41 FY 393	Mayer Farm	Mayer	1925	Unknown
41 FY 394	Zingleman-Sweningsen House/Farmstead	Sweningsen	Late 1800's	Unknown
41 FY 396	Finke-Matejowsky House	Finke	Wenzel Matejowsky/ 1800's	Unknown
41 FY 397	Emmet Lange Home/Farmstead	Lange	?	Unknown
41 FY 398	Sternadel Farm - House with Early Core	Sternadel or LCRA	?	Family relocated, Mine Maintenance Facility

41 FY 399	19th Century Farmhouse	Ansell		Topsoil Storage, new Road
41 FY 400	Site/well and steps	Bell Settlement School		
41 FY 401	1800's Farmstead and Original Cabin site	Matejowsky	Wenzel Matejowsky 1867, Log Cabin - ?	Drainage diversion pond, Induced Population & Traffic
41 FY 402	Store-Community	Matejowsky		Induced population and traffic
41 FY 403	Stone Folk Farmhouse/Blacksmith Shop	Wolff	Trauggot Sommer	
41 FY 404	Farmhouse	Wolff	House Core-mid 1800's	Ancillary Facilities
41 FY 405	Farmhouse	Meiner/Fuchs House		
41 FY 406	Site	Nechanitz School		
41 FY 407	Site	Waldeck School		
41 FY 408	Pyramidal House	Matejowsky	Petzold 1913	Conveyor
41 FY 409	Farmhouse with early core		Late 1800's	
41 FY 410	Railroad Depot/Carmine	Krause	Late 1800's	Conveyor
41 FY 411	Meeting Hall	Hermann's Sons, Hall	1902	
41 FY To be recorded	Site-Tenant House	Matejowsky	?	Diversion & Sediment Pond

41 FY 88	Rock Cairn	LCRA	Unknown	Excavation, Ash Disposal
41 FY 89	Site with well, Sugar Cane Processing Site	LCRA	Unknown	Land clearing/ Ash Disposal
41 FY 90	Burials	Believe to be Malcik Cemetery	Possibly 1929	Ash disposal (at low elevation within site)
41 FY 94	Burials	Biegel Cemetery	1866	Ash disposal (at high elevation within site)
41 FY 309	19th Century German folk structure	Harlfinger-Schumacher House LCRA	Charles Harlfinger 1880	
41 FY	Farmstead Remains/Barn/Well	LCRA		Ash disposal (at low elevation)
41 FY	Waldeck Church			

* Many of these sites are eligible for the National Register on their own merits.

** All will be affected by community losses, changes, etc.

Effects are estimated based on preliminary information.

Nechanitz - would be affected by project traffic, possibly induced population increase and construction of diversion ditches and wastewater ponds.

Waldeck - would be affected by road relocation, the conveyor, mine maintenance facility and traffic, and partly mined.

Ledbetter - would be affected by traffic, induced population and partly mined.

The beneficial impact to historic period cultural resources by such a project is that required surveys are conducted; resources are identified so that their significance can be recognized; and the need for historic preservation is made apparent.

Federal agencies' actions on permits and grants, etc., have the responsibility to comply with Section 106 of the National Historic Preservation Act. The major permit actions for this project that affect cultural resources and come under the NHPA include the Clean Water Act NPDES permits by EPA for wastewater discharges from the power plant areas, cooling reservoirs and mine area to streams; CWA, Section 404 permit by the Corps of Engineers; and Surface Mining Resources Reclamation Act permit by the RRC of Texas by delegation from the Office of Surface Mining, U.S. Department of Interior. Therefore, there are certain steps to be taken by EPA and others in accordance with the NHPA. The agency must coordinate with the Texas State Historic Preservation Officer. Also, EPA must consult with and obtain comments on the project from the Advisory Council on Historic Preservation (Council) which oversees the protective features of the NHPA, before a project can be considered cleared for permit action.

The NHPA provides for developing procedures for identifying resources, criteria for evaluating their significance, criteria for determination of effects (impacts) to resources, and provisions for mitigation, with avoidance being the desired option. The National Register of Historic Places was established and its criteria are used to determine local, state and national levels of significance. Effect is measured against the characteristics that qualify a cultural property (site, district or object) for eligibility for listing in for the Register.

Avoidance of impacts to significant prehistoric and historic properties and values is anticipated by the National Historic Preservation Act. When avoidance is not possible alternative mitigative measures are to be developed. The agencies have collaborated on review of the surveys conducted and on field visits for identification of significant prehistoric and historic properties, and on the Historic District determination. Specific avoidance and/or mitigation measures have not yet been developed. Public comments on such measures or alternatives are to be considered and included in the consultation documents submitted to the Council for review and comment.

General procedures that can be used at significant sites, if avoidance is impossible, includes the complete recordation of structures, sites, and activities through archeological investigations with scale mapping, scale drawings and detailed photographs in situ; and including dating analyses utilizing such as carbon techniques and tree-ring dating. The survey contractors are in the process of obtaining/providing information needed to complete survey of the mine and ash disposal areas, and are developing a plan for protection in the District, for agency review and approval.

Consultation with the Advisory Council will include a request for comment on the entire Fayette Power Project undertaking, including the actions taken at FPP Units 1, 2, 3 and 4, the Cedar Creek Reservoir, transmission lines, and the Cummins Creek mine and facilities. A draft letter of request for formal consultation and draft Preliminary Case Report are included in Appendix F.

If any NPDES permits are issued a Memorandum of Agreement, containing stipulations for cultural resource protection, would be included as a condition. The Texas State Historic Preservation Officer has recommended designation of a committee including the SHPO, EPA, and the applicant and possibly others to implement cultural resource management stipulations over the life of the project, if necessary. (Coordination meeting with SHPO, LCRA, TAS, EPA, February 26, 1985). A preliminary MOA without stipulations is included in Appendix F.

Protection of Historic Resources by Individual Owners. There are no requirements on individual owners due to this project or the NHPA. However, the State of Texas has encouraged the protection of historic properties by passing a law which provides for tax exemptions for such, as follows:

> § 11.24. Historic Sites
>
> The governing body of a taxing unit by official action of the body adopted in the manner required by law for official actions may exempt from taxation part or all of the assessed value of a structure and the land necessary for access to an use of the structure, if the structure is:
>
> 1. designated as a Recorded Texas Historic Landmark by the Texas Historical Commission and by the governing body of the taxing unit; or
>
> 2. designated as a historically significant site in need of tax relief to encourage its preservation pursuant to an ordinance or other law adopted by the governing body of the unit.
>
> (Vernons Annotated Texas Statutes, Chap. 11)

3.9 CUMULATIVE IMPACTS

The primary impacts considered in this EIS so far have been those associated with construction and operation of the FPP, Units 3 and 4, the Cummins Creek Lignite Mine and the Curved Overland Conveyor System. While a number of lignite-fueled electric generating stations, surface lignite mines and other lignite-fueled industrial activities are currently operating or planned for operation in Texas, the majority of these are located away from the proposed project area, principally in the east to northeast portion of the state. Rather than evaluating energy development in the entire state, this cumulative impact assessment is limited to projects planned or ongoing in the following counties: Fayette, Bastrop, Lee, Washington and Colorado.

LCRA maintains lignite leases in the first four counties listed above. Table 2-3 in Chapter 2 summarizes the quantity and quality of reserves held by LCRA (Lee County was not included since LCRA holds less than 200 acres). Currently the company is mining lignite on 158 acres of a 956-acre tract in Bastrop County, Texas. This Powell Bend Mine should provide approximately 2.0 million metric (MM) tons of lignite coal over a 10-year period.

There are federally-owned lignite reserves at Camp Swift Military Reservation in Bastrop County, which contain an estimated 70 to 90 MM tons of recoverable lignite. Although BLM prepared a Draft EIS in September 1980 describing impacts from development of proposed Camp Swift leasing of 6,600 acres, these lignite reserves have not been opened for competitive bidding. At this time it is not known when or if these reserves will be leased. It is expected, however, that should these reserves be opened for competitive bidding, LCRA would submit a coal lease application to BLM for consideration. Should LCRA be awarded the coal leasing at Camp Swift, it is expected that the mined lignite would fuel a new electric generating unit to be located in Bastrop County.

Although LCRA presently has no plans for developing electric generating units beyond numbers 3 and 4 at the FPP, there is a possibility that additional units could be constructed should LCRA determine that their power needs necessitated additional generating capacity. Such an expansion would require construction of a 1,400-acre reservoir on Baylor Creek, which is adjacent to the existing Cedar Creek reservoir. Any additional units would also likely be lignite-fueled and would require the mining of lignite in lease areas held by LCRA.

A dam and reservoir, the Colorado Coastal Plains Project, to be located southeast of the existing FPP, is being evaluated by the Bureau of Reclamation (BR). The BR has prepared both a draft status report (December 1981) and a preliminary findings report (September 1983) on this proposed water resources project. The primary purpose of the project is to provide a firm supply of water to meet projected industrial expansion and urban growth in the Lower Colorado River Basin. Water usage projections show that in the 1990's water needs will exceed supply capabilities of LCRA's existing supply facilities - the Highland Lakes above Austin. Other possible needs for additional water supplies in the area are: power, mining, fish and wildlife, recreation and environmental quality.

During the first phase of BR's study, 20 reservoir sites were investigated with 16 being eliminated from further consideration because of unacceptable yield or because of prohibitive cost in relation to obtainable yield. Study of the four promising sites-- two tributary (Clearview and Cummins Creek) and two main river (La Grange and Columbus Bend)-- showed that the main river dam sites developed 4 to 5 times the annual yield of the tributary sites. This first phase concluded that a dam and reservoir between La Grange and Columbus, Texas was the best alternative for development of additional surface water supply in the study area.

During the second phase of the study, five possible dam sites on the main stem of the Colorado River west of Columbus, Texas were considered. The Shaw's Bend site was determined to be the most economical of the five sites evaluated.

Also, a sixth alternative was developed in response to public inquiry about the possibility of building a series of small reservoirs instead of one large dam and reservoir at the Shaw's Bend site. The BR compared the alternatives and conlcuded one dam and reservoir at the Shaw's Bend site was the most viable alternative for meeting water needs in the lower basin.

The BR has coordinated with Federal, State and local agencies and the public throughout the study. Numerous meetings have been held and several newsletters distributed. The BR is currently preparing a Planning Report/Draft Environmental Statement (PR/DES) on the project. The PR/DES is expected to be available about September 1985, at which time it will be widely distributed for a 90-day review and comment period. The Planning Report/Final Environmental Statement (PR/FES) would then be filed about November 1986. This PR/FES would complete the first stage planning effort and the report would be the basis for seeking authorization for construction, if the project is ultimately determined to be feasible.

The following impact evaluation is quantitative where possible but the lack of specific data on the planned projects described above prevents quantification of some items.

Geology and Soils. The mining projects will remove approximately 304 million metric tons of lignite and will impact soils on approximately 16,500 acres. Soil impacts include increased erosion and possible loss of soil productivity despite reclamation.

Groundwater. Lignite mining will disrupt the groundwater systems. Potential short-term and long-term impacts include a deterioration of water quality and a decline of the groundwater levels. An unknown number of wells will be impacted in the short-term by mining, but no known municipal water wells should be adversely affected.

Surface Water. Adverse impacts from lignite mining on surface water quality should be minimal since surface water from disturbed areas would be routed to sedimentation ponds and held there until it meets discharge standards. While surface water quantity will increase with the damming of the Colorado River, Cummins Creek and Baylor Creek, the stream flows will be less than the existing levels, except for the Camp Swift project. With this project the median flow of Big Sandy Creek will increase tenfold resulting in increased bed erosion, increased carrying capacity for sediment, higher base flow and a potential for increased downstream water use. Regarding the damming of the Colorado River, it is estimated that flows into the estuary will be reduced by about 15% with the greatest reductions occurring during late summer and early fall. Preliminary data on the river borne sediment reaching the mouth of the Colorado River indicate a reduction from about 1,280 acre-feet per year to 550 acre-feet per year.

Air Quality. Increased emissions of sulfur dioxide, nitrogen oxides, total suspended particulates and radionuclides will result from the operation of the power plant units. The concentrations of these pollutants, however, should not result in adverse public health impacts. Increased levels of fugitive dust will result from lignite mining operations. And although the fugitive dust concentrations within the mining areas are high, the particles normally settle out quickly. No significant impacts on ambient air quality will result from mining activities.

Land Use. Pastureland, grazing land and undeveloped land are the major land use types in the area. Although these uses will be impacted in the short-term by mining, these land use categories will be re-established after reclamation. It should be noted, however, that landowner preference will affect what is re-established. Presently, it appears that there may be an increase in pastureland and a reduction in undeveloped land. Approximately 6,200 acres of cropland will be adversely impacted by the Colorado Coastal Plains Project.

Biological Resources. Approximately 4,700 acres of riparian habitat would be lost with the development of the Coastal Plains Project. An additional 600 acres of riparian habitat would be adversely affected by the Cummins Creek Project and approximately 4,000 acres of common Post Oak Savannah would be removed by the Camp Swift Project. Even though long-term recovery of the habitats affected by mining is possible, short-term adverse impacts to these communities will be significant. These projects will also cause many mobile wildlife species to move out of the affected areas while the less mobile species may disappear altogether. This would result in a reduction in quantity and quality of wildlife in post-project areas constituting short-term or long-term adverse impacts. Threatened or endangered species should not be affected by the projects; however, individual assessments of each project should be conducted, especially in regard to potential effects on Houston toad habitats at Camp Swift, Bastrop County.

Cultural Resources. Known and unknown archeological and historic sites would potentially be impacted by the projects; the exact number is not known since complete surveys have not been performed. Federal projects are subject to Section 106 requirements, which involve identification of these cultural resources, determinations of effects, and appropriate mitigation. The projects could cause long-term adverse impacts and irretrievable losses to the resource. Where information from properties is obtained through data recovery, excavation, etc., some long-term beneficial impacts of increasing public knowledge could also occur. The Fayette County and adjacent counties, being the eastern portion of the German belt in Texas, is considered the most endangered section of the German-Texan study unit as designed by the Texas Historical Commission in the Resource Protection Planning for Texas (THC, 1982).

Socioeconomics. The five-county region is largely rural in nature with scattered population centers. The proposed projects would create an influx of individuals to fill employment positions created as secondary effects. The number and impacts of these in-migrants on local communities are dependent on such factors as timing of the project, size of the project, existing labor pool, general economic health of the region, etc. Therefore, it is not possible to predict the exact impacts caused by these projects. In general, localized areas within the region could experience adverse impacts on housing availability, educational facilities, public services and transportation networks. In addition, beneficial impacts could occur to the local economies, individual's salaries and community finances.

Acid Deposition. Acid deposition is a term which describes the phenomenon in which SO_2, NO_x, and other air pollutants are converted to sulfuric acid, nitric acid, and other acids. These acids may form in the atmosphere and fall to the earth in the form of rain, snow, sleet, hail, or fog. The pollutants may also fall to the earth in a dry form awaiting some future precipitation or other source of moisture to transform them into acids and transport them through the ecosystem. The sources of the precursor pollutants contributing to acid deposition are both natural (including sea spray and lightning) and human induced. In most ecosystems, however, the relative contributions of each cannot be differentiated easily. Mankind's contributions come from a variety of sources, including electric power plants, industrial facilities, residential and commercial heating systems, waste combustion, and vehicle emissions.

Of these human contributions, Texas has displayed a significantly different emissions character than that of the eastern U.S., where about 65 percent of the resulting acids are sulfuric and about 30 percent are nitric (Arena, 1981). Statewide annual emissions and studies in major metropolitan areas indicate that NO_x emissions make a larger contribution to the acid deposition phenomenon in Texas than do SO_2 emissions (TENRAC, 1982). Another distinction can be seen in that electric power generation is often cited as the major cause of acid deposition in the eastern U.S., but it is ranked as the third largest contributor to the SO_2 (behind petroleum and metal-lurgical industry process losses) and NO_x (behind industrial fuel combustion and transportation) emissions burdened in Texas, as calculated for 1973 (TENRAC, 1982).

In Texas, substantial lignite reserves are being developed, often associated with mine-mouth power plants. As a result of this and a change in primary fuels, the relative proportion of SO_2 emissions attributable to electric power generation has probably increased since the 1973 study. However, some of these increases may have been offset by additional controls and more consistent control practices (TENRAC, 1982).

Approximately half of the existing SO_2 and NO_x emission sources are located east of a line drawn from Corpus Christi through Dallas-Ft. Worth to the Red River (TENRAC, 1982), which would include the project site. In addition, it is probable that future lignite-burning power plants will be located along the east Texas lignite belt, running in a northeasterly direction from south of San Antonio into Arkansas and Louisiana. In spite of the fact that wind directions in this area vary considerably, the general flow of surface winds associated with synoptic frontal systems is in a northeasterly direction. As a result, northeast Texas and perhaps portions of Arkansas and Louisiana would be the areas most prone to experience impacts from acid deposition from sources located along the lignite belt (TENRAC, 1982 and 1983 and Arena, 1981).

The sensitivity of some of the soils in that region might add to the potential for experiencing impacts from acid deposition. These effects on soils are generally thought to be chronic and discernible only over a period of years. Nevertheless, a recent study by the Texas Energy and Natural Resources Advisory Council (TENRAC, 1982) has concluded that "there is little evidence to indicate that deleterious effects will occur to most of the soils in Texas. One possible exception is the East Texas Timberland resource area. Many of the soils there are sandy, particularly at the surface and, due to parent materials, climate, and vegetation, are acidic in nature. Immediately below the surface they are low in organic matter. These combined factors cause the soils there to have a low buffering capacity and to be low in alkaline material. They have a relatively low potential for neutralizing acids from outside sources." Furthermore, the report states that "the ease with which water moves through the more sandy soils might allow acid groundwater (as a result of continued additions of acid precipitation) to flow into local lakes and streams."

Attempts to determine the progression of acidity in some lakes have been made from field studies, long-term water quality data, fish pollution declines, and lake sediment studies. However, the information gathered so far has been inadequate to draw conclusions with regard to trends. There does appear to be a critical point in the process, however, at which acidification suddenly occurs. The answers to the questions of how long it takes either to acidify or for acidified lakes to recover are also uncertain. Estimates range from five years to several decades.

Scientists have used alkalinity data on surface waters to identify and describe areas where lakes and streams may be vulnerable to damage from acid rain. Field studies have confirmed increased acidity in lakes and streams with low alkalinity.

The existing sensitivity to acid deposition of surface waters in east Texas varies considerably. An EPA study (EPA, 1982) of total alkalinity, an expression of the acid neutralizing capacity of water bodies, has shown average variations between >2000 ueq./l (a low sensitivity) and <200 ueq./l (a high sensitivity) [Figure 3-33]. Localized or regional impacts on surface water, groundwater, or aquatic biota related to acid deposition have not been documented nor predicted with any degree of certainty within the project area.

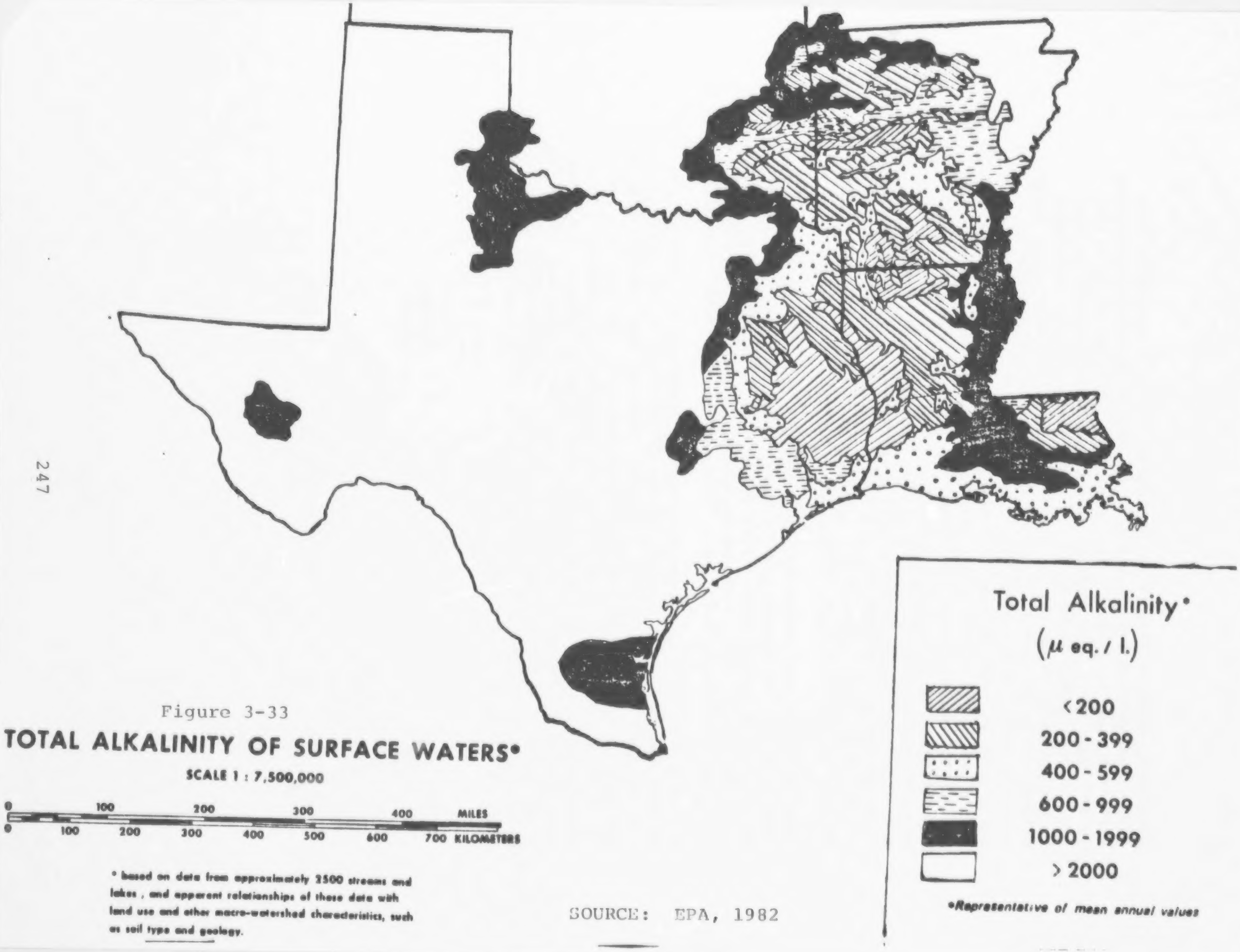

Total Alkalinity*
(μ eq. / l.)
▨ <200
▨ 200 - 399
░ 400 - 599
▤ 600 - 999
■ 1000 - 1999
☐ > 2000
*Representative of mean annual values
SCALE 1 : 7,500,000
0 100 200 300 400 MILES
0 100 200 300 400 500 600 700 KILOMETERS

Figure 3-33

TOTAL ALKALINITY OF SURFACE WATERS*

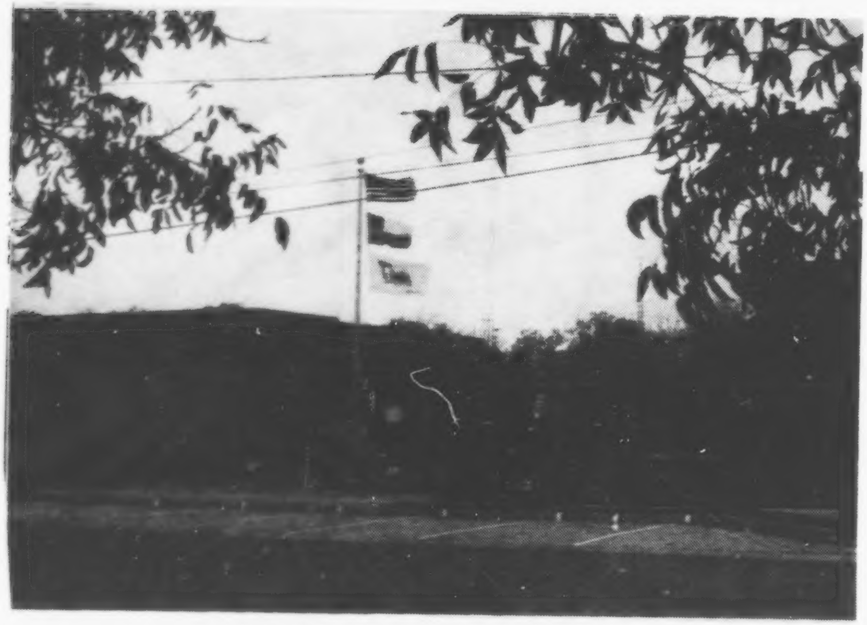
* based on data from approximately 2500 streams and lakes, and apparent relationships of these data with land use and other macro-watershed characteristics, such as soil type and geology.

SOURCE: EPA, 1982

Similarly, negative effects on vegetation in east Texas due to acid deposition have not been documented, although Texas Air Control Board monitoring has indicated the presence of acid precipitation in the Tyler, Texas area. The dominant native vegetation type in the area, the oak-pine forest association, is known to be somewhat vulnerable to air pollution impacts. It is also postulated, however, that these effects may be mitigated to some extent by increased atmospheric supplies of nitrates and sulfates, associated with acid deposition, which serve as plant nutrients (TENRAC, 1982). The Texas Energy and Natural Resources Council study also reports that "commercially important plant species in northeast Texas may also be sensitive to acid deposition. Pine plantations and other managed timberlands occurring on poorly buffered sandy soils are prone to damage due to their lack of artificial fertilization and liming, their high dependence on nitrogen fixation (which is impaired by acidification), the relative infertility of the soils, and a known direct sensitivity of pines, the major timber source, to acid deposition (Smith, 1981)."

Human health effects caused by acid deposition have been postulated but remain speculative (Mough, 1984). However, ambient concentrations of sulfur dioxide and nitrogen oxides are regulated through Federal and State ambient air quality standards, and emissions of these substances are regulated through Federal and State "New Source Review" regulations.

In conclusion, limited and unquantifiable adverse impacts attributable to acid deposition from the combination of sources existing and proposed for this area are foreseeable. Emissions from the proposed expansion of the Fayette Power project alone are projected to account for less than 5% of the statewide SO_2 and NO_x point source emissions. However, since the consequences have been seen to be significant in other areas of the country and in other parts of the world, additional study and monitoring is warranted. In that regard, EPA is conducting a large scale lake survey in order to gain a better understanding of the type and number of lakes in the country affected by acid rain.



City Hall - LaGrange

CHAPTER 4

COORDINATION

CHAPTER 4 COORDINATION

4.1 SCOPING PROCESS

A notice of intent to prepare an EIS on the issuance of new source NPDES permits to LCRA for wastewater discharges from Units 3 and 4 of the FPP, and the Cummins Creek Lignite Mine, was issued by EPA, Region 6, on April 12, 1984. Federal, State and local agencies and the public were invited to participate in the process for determining the scope of issues to be addressed and for identifying the significant issues related to the proposed actions. A public meeting to receive input was held on May 22, 1984, at the Fayette County Courthouse in La Grange, Texas. Approximately 175 persons attended and major comments received include the following:

° The effects of surface mining on surface water quality and quantity;
° The potential effects of power plant emissions on regional air quality and public health;
° The presence of uranium and heavy metals in overburden and the associated health effects from mining and lignite combustion;
° The project impacts on plants and animals including threatened or endangered species;
° The effects of mining on ground water quality, aquifer recharge, depressurization and dewatering of private wells;
° The socioeconomic impacts of the project including changes in employment, tax base, community infrastructure and oil and gas leasing and production;
° The changes in land use from mining and reclamation;
° The potential for adequate reclamation and the effects of mining on topography;
° The combined effects of this proposed project along with other existing and planned projects;
° The project impacts on historic and cultural resources;
° The effects of noise from the project; and
° The inclusion of adequate baseline data for impact evaluation.

EPA has addressed these concerns to the maximum extent practicable in this Draft. Other concerns raised during the scoping process, including project impacts on State highways and traffic and project impacts on recreation are also addressed to the maximum extent practicable.

4.2 COOPERATING AGENCIES

EPA, Region 6, sent 16 letters to various Federal and State agencies requesting their participation in the review and preparation of this EIS. EPA received affirmative responses from the U.S. Soil Conservation Service, the U.S. Corps of Engineers, the U.S. Fish and Wildlife Service, the Texas Department of Health, the Texas Historical Commission, the Railroad Commission of Texas, the Texas Department of Highways and Public Transportation, and the Texas Parks and Wildlife Department.

4.3 SIGNIFICANT CORRESPONDENCE

Copies of significant correspondence concerning development and preparation of the EIS are presented at the end of this chapter.

4.4 EIS REVIEW PROCESS

The notice of availability of this Draft EIS in the Federal Register initiates a 45-day comment period during which comments are solicited from Federal, State, and local agencies, groups, and individuals. A public hearing will be held in La Grange, Texas after the Draft has been available for review for 30 days. After the public hearing and end of the comment period, EPA will respond to the comments received and prepare and distribute the Final EIS. Comments on the Final EIS will be received during a 30-day review period. EPA will consider all comments received during the review periods in making its decision on the NPDES permit actions. A Record of Decision will then be issued, which will document the end of the NEPA process and EPA's final permit decisions.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION VI
1201 ELM STREET
DALLAS, TEXAS 75270

APR 0 2 1985

Mr. Elof H. Soderberg
General Manager
Lower Colorado River
Authority
P.O. Box 220
Austin, Texas 78767

Re: Early Construction of the Cummins Creek Lignite Mine

Dear Mr. Soderberg:

We have reviewed your letter dated March 5, 1985, requesting the Environmental Protection Agency's (EPA's) approval for early construction of the Cummins Creek Mine Support Facility (i.e., the site to erect the dragline and bucketwheel excavator, surface water control structures, topsoil stockpile and access road) and the upgrading of County Road 133. Based on the information currently available, including data provided in the Surface Mining and Reclamation Permit Application for the Cummins Creek Support Facility, we have made the following determinations:

1. The proposed construction will not cause significant or irreversible adverse environmental impact and the Lower Colorado River Authority (LCRA) may therefore commence construction of the mine support facility and the upgrading of County Road 133 in accordance with 40 CFR 122.29 (c)(4)(i).

2. LCRA will not discharge effluent from the proposed sedimentation pond prior to issuance of EPA's NPDES permit.

3. EPA's decision to approve early construction of the support facility and the upgrading of County Road 133 does not obligate EPA in any way regarding its final NPDES decision for the Cummins Creek Lignite Mine.

4. Should the NEPA review by EPA, Region 6, result in a determination that the NPDES permit for the mine is denied or that the proposed support facility should not be constructed at the proposed location, LCRA agrees to return the area disturbed to its approximate original contour and revegetate the area to the satisfaction of EPA.

5. This authorization recognizes that historic sites (41FY297, 41FY403, and 41FY404) and contributing members of the Fayette Power/Rabbs-Cummins Creek Mine Historic District, determined to be eligible for nomination to the National Register, occur in the vicinity of the proposed construction on County Road 133. Information from LCRA indicates that the presently proposed construction will not directly affect these or other historic/prehistoric sites. However, if new information indicates otherwise, LCRA shall immediately cease construction, notify EPA and agree to take measures to protect/mitigate these resources to the satisfaction of EPA and the Texas State Historic Preservation Officer.

6. EPA reserves the right to withdraw this authorization should new information indicate that significant adverse environmental impacts will result from the construction. In such an event, LCRA shall immediately cease construction activities and take measures to restore the affected environment, if necessary.

Please advise us of the date construction starts and keep us informed of your activities relative to this authorization. If you have any questions regarding this decision or the stipulations to this approval, please contact Clinton B. Spotts at (214) 767-2716.

Sincerely yours,

Dick Whittington, P.E.
Regional Administrator

DEPARTMENT OF DEFENSE
UNITED STATES OF AMERICA

DEPARTMENT OF THE ARMY
GALVESTON DISTRICT, CORPS OF ENGINEERS
P.O. BOX 1229
GALVESTON, TEXAS 77553

REPLY TO
ATTENTION OF:

February 12, 1985

Compliance & Special
Actions Section

RECEIVED
FEB 19 1985
6 ES

Mr. Clinton B. Spotts
Regional EIA Coordinator
United States Environmental Protection Agency
Region VI
1201 Elm Street
Dallas, Texas 75270

Dear Mr. Spotts:

This is in reference to your January 16, 1985 letter requesting our review of and comments on the preliminary draft of EIS on the Lower Colorado River Authority (LCRA) Cummins Creek Project, Fayette County, Texas.

This office was originally advised of the proposed project in a February 16, 1983 letter from Mr. Don L. Scraggins. The letter requested a determination of Department of the Army permit requirements for the proposed project. Corps of Engineers personnel inspected the proposed project area on March 1, 1983. In a March 4, 1983 letter, Mr. Scraggins was advised of the Corps of Engineers jurisdiction over the proposed project. This letter supersedes our March 4, 1983 letter to Mr. Scraggins.

The Department of the Army has jurisdiction over discharges of dredged or fill material into waters of the United States pursuant to Section 404 of the Clean Water Act. Within the project area, jurisdiction is limited to the stream channels and impoundments. The nature of the terrain is such that there are no jurisdictional wetlands outside the cut banks of the stream channels, as determined during the March 1, 1983 field inspection.

The proposed project is authorized pursuant to 33 C.F.R. 330.5(a)(21), nationwide permit for structures, work, and discharges associated with surface coal mining activities. Provided the activities are authorized by the Department of the Interior, Office of Surface Mining, or by states with approved programs under Title V of the Surface Mining Control and Reclamation Act of 1977. Further provided that the District Engineer is given the opportunity to review the Title V application and all relevant state documentation prior to any decision on the application, and the District Engineer makes a determination that the individual and cumulative adverse effects on the environment, from such structures, work, or discharges are minimal.

In order for the nationwide permit identified to be valid, the special conditions as identified in 33 C.F.R. 330.5(b) and as listed on the attached sheet, must be followed. In addition to the conditions specified in 33 C.F.R. 330.5(b), the management practices identified in 33 C.F.R. 330.6(a), and as also listed on the attached sheet, should be followed to the maximum extent practicable. Failure to comply with these practices may be cause for the District Engineer to recommend or the Division Engineer to take discretionary authority to regulate the activity on an individual or regional basis.

This nationwide permit does not convey any property rights, either in real estate or material, or any exclusive privileges; and it does not authorize any injury to property or invasion of rights or any infringement of Federal, State, or local laws or regulations nor does it obviate the requirement to obtain State or local assent required by law for the activity authorized herein. Further, no dredging or filling in navigable waters of the United States is authorized by this nationwide permit.

For more information on this matter please contact Mr. Tony Vazquez at the letterhead address or at (409) 766-3947.

Sincerely,

Fred L. Anthamatten
Chief, Compliance and Special
Actions Section

Attachment

33 C.F.R. 330.5(b) Conditions

Reproduced from best available copy.

a. That any discharge of dredged or fill material will not occur in the proximity of a public water supply intake.

b. That any discharge of dredged or fill material will not occur in areas of concentrated shellfish production unless the discharge is directly related to a shellfish harvesting activity.

c. That the activity will not jeopardize a threatened or endangered species as identified under the Endangered Species Act, or destroy or adversely modify the critical habitat of such species.

d. That the activity will not significantly disrupt the movement of those species of aquatic life indigenous to the water body (unless the primary purpose of the fill is to impound water).

e. That any discharge of dredged or fill material will consist of suitable material free from toxic pollutants in toxic amounts.

f. That any structure or fill authorized will be properly maintained.

g. That the activity will not occur in a component of the National Wild and Scenic River System.

h. That the activity will not cause an unacceptable interference with navigation.

i. That the best management practices listed in 33 C.F.R. 330.6 of this part should be followed to the maximum extent possible.

33 C.F.R. 330.6(a) Management Practices

a. Discharges of dredged or fill material into waters of the United States shall be avoided or minimized through the use of other practical alternatives.

b. Discharges in spawning areas during spawning seasons shall be avoided.

c. Discharges shall not restrict or impede the movement of aquatic species indigenous to the waters or the passage of normal or expected high flows or cause the relocation of the water (unless the primary purpose of the fill is to impound waters).

d. If the discharge creates an impoundment of water, adverse impacts on the aquatic system caused by the accelerated passage of water and/or the restriction of its flow shall be minimized.

e. Discharge in wetlands areas shall be avoided.

f. Heavy equipment working in wetlands shall be placed on mats.

g. Discharges into breeding areas for migratory waterfowl shall be avoided.

h. All temporary fills shall be removed in their entirety.

COOPERATIVE AGREEMENT
BETWEEN THE
LOWER COLORADO RIVER AUTHORITY
AND THE
FAYETTE SOIL AND WATER CONSERVATION DISTRICT

RELATIVE TO: TECHNICAL ASSISTANCE ON LAND IN FAYETTE COUNTY FOR LAND USE PLANNING AND RECLAMATION.

THIS AGREEMENT, made and entered into the 8th day of Feb. 1985 by and between Lower Colorado River Authority (hereinafter called "LCRA"), and the Fayette Soil and Water Conservation District (hereinafter called "District"). LCRA, for planning and land treatment purposes has requested technical and other assistance which the district may have available. The District, in carrying out its objectives and responsibilities provides leadership and sets priorities for technical and other assistance. Therefore, LCRA and the District deem it mutually advantageous to cooperate in this undertaking and hereby agree as follows.

LCRA agrees:

1. To use technical and other assistance available which is provided by the District for the purpose of conservation planning, treating and managing lands involved in "Cummins Creek Lignite Mining Project".
2. Where practical, during the mining process, to provide erosion control such as, but not limited to, temporary vegetation and structures.

3. To use the district technical and other assistance for the purpose of reclaiming mined lands and to use these lands within their capabilities and to treat the land in keeping with its needs.

4. LCRA agrees, where practical, to involve the landowner in the mining reclamation plan on each of their respective units.

5. Maintain all conservation measures and structures in an effective condition.

The District agrees to:

1. Assist in carrying out the conservation plan by furnishing the LCRA information, district and soil conservation service technical assistance, supervision, and other assistance that may be needed, if available.

It is further agreed that:

1. This agreement will become effective on the date of the last signature and with at least thirty (30) days prior written notice to the other party may be terminated by either party. This agreement may be modified only by the mutual agreement of both parties.

2. The provisions of this agreement are understood by the LCRA and the District. Neither shall be liable for damage to the others property resulting from carrying out this agreement unless such damage is caused by negligence or misconduct.

LOWER COLORADO RIVER AUTHORITY

2-8-85
Date

By: Elof H. Soderberg
Elof H. Soderberg
General Manager

FAYETTE SOIL AND WATER
CONSERVATION DISTRICT

2-6-85
Date

By: Lawrence Friedrich
Lawrence Friedrich
Chairman

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
17629 El Camino Real,Suite 211
Houston, Texas 77058

JUL 05 1984

RECEIVED
JUL 10 1984
6 ES

Mr. Clinton B. Spotts
Regional EIS Coordinator (6ES-F)
U.S. Environmental Protection Agency
1201 Elm Street
Dallas, Texas 75270

Consultation No. 2-13-84-I-35

Dear Mr. Spotts:

This is in reply to your letter of June 21, 1984, which requested comments regarding the effect of a proposed Power Project and Lignite Mining activity upon listed species or species proposed to be listed as threatened or endangered. Your area of interest is Fayette County, Texas.

As provided by the Endangered Specvies Act, the Fish and Wildlife Service furnishes, upon request, information concerning those species, both proposed and listed, which may be affected by various activities.

Our data indicate that there are no listed or proposed to be listed species within Fayette County. However, our data do show that several endangered species are included within adjacent counties. These include:

1. Houston Toad - Bastrop and Burleson counties,
2. Whooping Crane - Crosses Fayette and the adjacent counties during its migration,
3. Attwaters Prairie Chicken - Colorado, Wharton, Fort Bend counties, and
4. Bald Eagle - Colorado county.

We appreciate the opportunity to comment. If I may be of further assistance, do not hesitate to call this office at (713) 229-3681.

Sincerely yours,

H Dale Hall

H. Dale Hall
Field Supervisor

cc:
Executive Director, Texas Parks and Wildlife Department, Austin, TX
Regional Director, FWS, Region 2, Albuquerque, NM (SE)

LAPIDARY
COLD DRINKS

Rock Shop - Ledbetter

LIST OF PREPARERS

LIST OF PREPARERS

The following is the list of individuals involved in the preparation of the Draft EIS:

U.S. Environmental Protection Agency

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Lee Wilson
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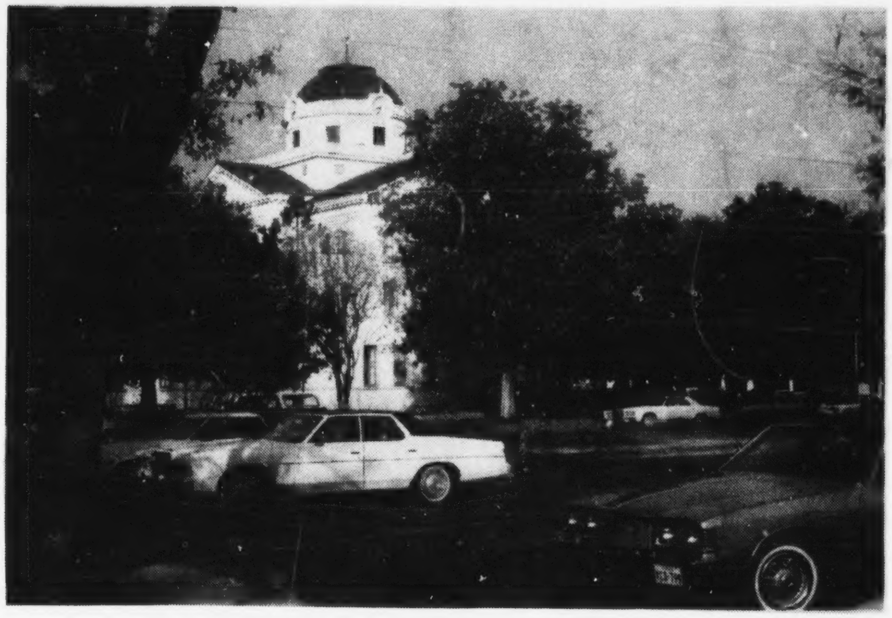

Colorado County Courthouse - Columbus

LIST OF AGENCIES, ORGANIZATIONS AND PERSONS TO WHOM COPIES OF THE DRAFT STATEMENT ARE SENT

LIST OF AGENCIES, ORGANIZATIONS, AND PERSONS TO WHOM COPIES OF THE DRAFT STATEMENT ARE SENT

Listed below are the major governmental offices and public interest groups which will receive a copy of the Draft EIS. In addition, numerous other governmental organizations, public groups and interested individuals will also receive a copy of the document.

Federal

Soil Conservation Service
Department of the Interior
Department of Commerce
Department of Transportation
Department of Agriculture
Department of Energy
Advisory Council on Historic Preservation
National Park Service
Office of Surface Mining
Agricultural and Stabilization Service
Department of Housing and Urban Development
Public Health Service
Department of Health and Human Services
Army Corps of Engineers
Fish and Wildlife Service
Federal Emergency Management Agency
Senator Lloyd Bentsen
Senator Phil Gramm
Representative Mac Sweeney

STATE OF TEXAS

Office of Planning and Budget
General Land Office
Department of Health
Department of Highways and Public Transportation
Railroad Commission
Historical Commission
Department of Water Resources
Parks and Wildlife Department
Department of Agriculture
Air Control Board
Bureau of Economic Geology
Governor Mark White

PUBLIC INTEREST GROUPS

Fayette County Resource Watch
Sportsmen's Clubs of Texas
Natural Resources Defense Council
Wildlife Management Institute
Audubon Society
Sierra Club
Texas Committee on Natural Resources
League of Women Voters
Texas Environmental Coalition
Central Texas Lignite Watch
Common Cause
Texas Conservation Council
Citizen's Action Program

Downtown - Schulenburg

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Lutheran Church - Waldeck

GLOSSARY

GLOSSARY

Acid Rain. Rain of low pH (usually less than 5.7) postulated to have many detrimental effects on calcareous structures or on aquatic and terrestrial systems in areas with low buffering capacity. Caused by airborne gases and soluble particles that form acids in rainwater, either emitted from man-made (industrial, automobiles) or natural (fires, volcanoes) sources. In general use, includes dry deposition of acidifying materials as well.

Acre-Foot. A term used in measuring the volume of water, equal to the quantity required to cover one acre one ft. in depth, or 43,560 cu. ft.

Atmospheric Inversion. A condition which occurs when the air near the earth is cooler than the air above. The result is a stable atmosphere in which layers do not mix and ground level air becomes stagnant (also see Temperature Inversion).

Baghouse. A dust removal device consisting of fabric filter elements inside an enclosed structure. Dust laden air enters the bags, the dust collects on the bags and the cleansed air exits.

Bioaccumulation. An environmental transport process which concentrates rather than diffuses chemicals. This concentration effect is expressed as the ratio of the concentration of a chemical in the organism to that in the medium (usually water).

Biomagnification. The buildup in concentration of some substance, such as DDT or some radioactive isotopes, in successively higher trophic levels of the food chain or web.

Boiler Blowdown. Method of preventing buildup of naturally occurring solids found in boiler feedwater. Also known as "Demineralizer Blowdown".

Bottom Ash. Coal ash that either settles or adheres to the interior furnace surfaces in the form of fine particulate or sludge.

Box Cut. The initial cut driven in a property, where no open side exists; this results in a highwall on both sides of the cut.

BTU - British Thermal Unit. The quantity of heat required to raise the temperature of one pound of water one degree (F).

Bucketwheel Excavator (BWE). A continuous digging machine composed of a boom on which is mounted a rotating vertical wheel having buckets on its periphery. As the rotating wheel is pressed into the material to be excavated, the buckets scoop material and discharge it onto a conveyor belt system for transport to loading or dump sites.

Busbar Energy Cost. The cost of production and generation of energy. Includes capitalization costs but not energy transmission costs.

Cation Exchange Capacity. The sum total of exchangeable cations that a soil can adsorb. Sometimes called "total exchangeable capacity," "base-exchange capacity" or "cation adsorption capacity," expressed in milliequivalents per 100 grams of soil or other adsorbing material.

CO. Carbon monoxide.

Conductivity. The ability to carry an electrical charge, in ions. The conductivity of aqueous solutions is increased by dissolved salts and thus is a measure of the amount of ionized salts in solution.

Cubic Feet Per Second (cfs). Units used to measure flow at a gaging station, equals the rate of flow in a channel with a one-square-foot cross-section and velocity of one foot per second. One cfs for a 24-hour period equals 86,400 cubic feet or 1.98 acre-feet.

Curie (Ci). The basic unit describing radioactivity, is 37,000,000,000 disintegration per second, approximately equaling that of one gram of Radium-226. Smaller units such as the picocurie (p Ci) or one millionth of a millionth of a Curie are used in this discussion.

dBA. The sound level obtained by use of A-weighting. The unit is the decibel, dB, and is followed by the letter "A" to indicate A-weighting. The A-weighting network best simulates the human ear's response to sound pressure.

Disturbed Area. An area where vegetation, topsoil or overburden is removed or upon which topsoil, spoil, coal processing waste, underground development waste or noncoal waste is placed by surface coal mining operations. Those areas are classified as disturbed until reclamation is complete and the performance bond or other assurance of performance is released.

Diversion.

1. Channel constructed across the slope for the purpose of intercepting surface runoff. Changing the accustomed course of all or part of a stream. Also, a ditch or canal by which water is diverted from one stream to another.

2. A channel, embankment or other man-made structure constructed to divert water from one area to another.

Dragline. An excavating machine that utilizes a bucket operated and suspended by means of lines or cables, one of which hoists or lowers the bucket from a boom; the other, from which the name is derived, allows the bucket to swing out from the machine or to be dragged toward the machine for loading. Mobility of draglines is by crawler mounting or by a walking device featuring pontoon-like feet and a circular base or tub. The swing of the machine is based on rollers and rail. The machine usually operates from the highwall.

Electrostatic Precipitator. A device that uses an electrical charge to remove particulates from an effluent airstream.

End Lake. Last active mining pit; not backfilled, but allowed instead to fill with water.

Exchangeable Bases. Soil cations (positively charged ions), such as Potassium (K+), Calcium (Ca++), Magnesium (Mg++), and Hydrogen (H+) that are available to the soil solution.

Fecal Coliform. Aerobic bacillus which is present in the excrement of warm blooded animals. The coliform group is considered a reliable indicator of the treatment for bacterial pathogens.

Flue Gas. Any gas that is ducted through flue or chimney and expelled to the atmosphere.

Fly Ash. Coal ash particulate matter that is entrained into the flue gas stream.

Fugitive Dust. That particulate matter not emitted from a duct or stack which becomes airborne due to the forces of wind or surface coal mining and reclamation operations or both. During surface coal mining and reclamation operations it may include emissions from haul roads; wind erosion of exposed surfaces, storage piles and spoil piles; reclamation operations; and other activities in which material is either removed, stored, transported or redistributed.

Gamma Log Anomalies. An anomalous (twice background) measurement of the intensity of a broad spectrum undifferentiated natural gamma radiation from rocks or sediments in a cased or uncased bore hole.

GPD. Gallons per day.

Horizons. Numbers ending in 500 have been assigned the lignite units at the Cummins Creek Mine. The lowest lignite horizon is numbered 1,500, with an increase as lignite seams occur higher in the stratigraphic profile. Horizons not ending in 500 represent associated non-lignite seams.

Interburden. Material of any nature, consolidated or unconsolidated, that lies between two deposits of useful minerals (lignite).

Kilowatt-Hour (KWH). A measure of energy or work.

$L_{(dn)}$. Day-Night Sound Level. The 24-hour equivalent sound level with a penalty value of 10 dBA added to the average levels occurring during the nighttime hours of 10:00 p.m. to 7:00 a.m.

LC_{50}. Fifty percent of the lethal concentration.

Line Sink. A linear hydrologic outflow boundary such as a mine highwall, or flow to an infinitely long line of wells.

Megawatt (gross) MW. The total amount of power that is produced in a power plant including that used by the plant itself.

Megawatt (net) MW. The amount of power that is transmitted from a power plant.

MEQ/100G. Milliequivalents per 100 grams. Used to express cation exchange capacity. A MEQ is 1 milligram of hydrogen or the amount of any other ion that will combine with or displace it.

Million Gallons Per Day (MGD). A unit of measurement for expressing the flow rate of water through a certain point.

Mine-Mouth Plant. A steam-electric plant or coal gasification plant built close to a coal mine; usually associated with delivery of output via transmission lines or pipelines over long distances, as contrasted with plants located nearer load centers and at some distance from sources of fuel supply.

Mitigation

1. Avoiding the impact altogether by not taking a certain action or parts of an action.
2. Minimizing impacts by limiting the degree or magnitude of the action and its implementation.
3. Rectifying the impact by repairing, rehabilitating or restoring the affected environment.
4. Reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action.

MM BCY. Million metric bank cubic yards.

MM T. Million metric tons.

mmhos/cm. Millimoles per centimeter. One thousandth (10^{-3}) umhos/cm.

NO_2. Nitrogen dioxide. A gaseous atmospheric pollutant formed primarily during combustion of fossil fuels.

NO_x. A combination of various oxides of nitrogen, the most common of which are nitric oxide (NO) and nitrogen dioxide (NO_2). Formed by combustion processes.

Overburden. Consolidated or unconsolidated material overlying a deposit of useful geological material (minerals, ores, lignite, or coal) especially where mined by open cuts.

Particulates. Small particles of solid or liquid materials that, when suspended in the atmosphere, constitute an atmospheric pollutant.

Pedon. Smallest soil sampling unit of sufficient size to allow horizon and soil property study - usually from one to 10 square meters in size.

Percent Base Saturation. The proportion of the cation exchange capacity of a soil that is occupied by exchangeable bases.

Piezometer. An instrument for measuring pressure or compressibility of a material subjected to hydrostatic pressure.

Radionuclide. A radioactive species of atom characterized by the energy level and the number of protons and neutrons contained in its nucleus.

Radon Emissions. The release of radon gas previously trapped in rocks or soils.

Reclamation (Rehabilitation)

1. The process of reconverting mined or other disturbed land to its former or other productive uses.
2. The process of making a site habitable to organisms that were originally present or others that approximate the original inhabitants.

3. Those actions taken to restore mined land to a postmining land use approved by the regulatory authority.

Rem. The basic unit of radiation protection, produces the same amount of biological damage regardless of its source. The millirem is defined to be one thousandth of a rem.

Revegetation. Reestablishment and maintenance of growth of plants to replace original ground cover following land disturbance.

Riparian. Relating to the bank of a natural water course, such as a river, lake, or stream.

Roll Front. A term that characterizes a uraniferous deposit in sediments, usually sands, where uranium is precipitated from solution at or near the redox contacts, i.e. the transition zone from oxidized to reduced ground water chemistry.

Runoff. That portion of the rainfall that is not absorbed by the deep strata. It is utilized by vegetation or lost by evaporation or may find its way into streams as surface flow.

Scrubbers. An apparatus for removing impurities, especially from gases.

Sediment. Solid material, both mineral and organic, that is in suspension, is being transported, or has been moved from its site of origin by air, water, gravity or ice and has come to rest on the earth's surface either above or below sea level.

Sedimentation Pond. A primary sediment control structure including but not limited to a barrier, dam or excavated depression which slows down water runoff to allow sediment to settle out.

Selenium. A trace element which in elemental form is practically non-toxic; however, hydrogen selenide and other selenium compounds are extremely toxic.

Sinking Fund. An investment fund into which an annual deposit is made in order to obtain a known sum of money at a future period in time.

Soil Horizons. Layers within the soil, approximately parallel to the surface of the soil. Horizons are formed by soil-forming processes and have distinct characteristics.

Soil Moisture Suction.

- 1/3 Bar % - Tension at which water is held by a soil at field capacity (1/3 atmosphere of tension). Water is held in soil against the downward flow of gravity and is available to plants.
- 15 Bar % - Tension at which water is held by soil particles when soil moisture is at the wilting point or critical moisture (15 atmospheres). Water remaining in the soil is not readily available to plants.

Sulfur Dioxide (SO_2). A gaseous air pollutant that is produced primarily by the combustion of fossil fuels and petroleum refining.

Soluble Bases. Those soil cations (Ca, Mg, Na, K) that are capable of entering the soil solution (see Exchangeable Bases).

Specific Conductance. A measure of ions in solution; for liquids it is a measure of the dissolved solids.

Spoil

1. The overburden or non-coal material removed in gaining access to the coal or mineral material in surface mining.
2. Overburden that has been removed during surface coal mining operations.

Stripping Ratio. Ratio of cubic yards of overburden removed per ton of coal removed. This is the major factor limiting the depth of economic resource removal.

Sulfate. A compound in which the hydrogen of sulfuric acid is replaced by either a metal or by an organic radical.

Surge Pile. An area serving as a buffer between the mine and overland conveyor. The stockpile - reclaim system is of the slot storage type and consists of a tripper conveyor with a tripper car to load incoming lignite from the mine and a reclaim conveyor with two plow feeders to load lignite onto the overland conveyor.

Temperature Inversion. A stable layer in the atmosphere in which temperature increases with altitude. (also see Atmospheric Inversion).

Thermocline. The point at which the surface water temperature change 1°C for every one meter change in water depth.

TLV. Threshold Limit Value. A time-weighted average concentration developed by the American Conference of Governmental Industrial Hygienists, for a normal 8-to-10-hour workday or 40-hour workweek, to which nearly all workers may be repeatedly exposed, day after day, without significant adverse effect.

TOPSOIL. Presumed fertile soil material - used as a top dressing. Distinction has been made among synthetic, weathered and geologic topsoil. Synthetic topsoil can include sand and stone chips as well as fly ash, sawdust or manure not usually a part of geological soil and rock. Weathered topsoil is the natural top-dressing material that has been subjected to weathering throughout geologic time.

TURBIDITY. The reduction of transparency of water due to the presence of suspended particulate matter. Such material may consist of clay or silt, finely divided organic matter or microscopic organisms which cause light to be scattered and absorbed rather than transmitted in straight lines through the sample.

ug/m^3. Microgram per cubic meter.

umhos/cm. Micromoles per centimeter. A unit of measure for electrical conductivity which measures soil salinity.

Watershed. A region or area bounded peripherally by a water parting and draining ultimately to a particular watercourse or body of water.

"Worst Case". A situation in which the combination of factors that would produce the worst potential impact on the environment are considered.

Country Store - Oldenburg

APPENDIX A

DRAFT NPDES PERMITS

UNITED STATES
ENVIRONMENTAL PROTECTION AGENCY
REGION 6
DALLAS, TEXAS

IN THE MATTER OF:	:	
LOWER COLORADO RIVER AUTHORITY FAYETTE POWER PROJECT UNIT 3	:	EARLY CONSTRUCTION AGREEMENT FOR FAYETTE UNIT 3
NPDES PERMIT NO. TX0073121	:	

WHEREAS the LOWER COLORADO RIVER AUTHORITY (LCRA) has a request before the UNITED STATES ENVIRONMENTAL PROTECTION AGENCY, REGION 6 (EPA) to modify its NPDES Permit No. TX0073121 to cover Fayette Unit 3 to be constructed;

WHEREAS EPA has determined to prepare an Environmental Impact Statement (EIS) and whereas, 40 CFR 122.29(c)(4)(i) forbids on-site construction of a new source for which an EIS is required unless the applicant executes a legally-binding written agreement which requires compliance with all EIS requirements;

WHEREAS LCRA has requested permission as provided in the regulations to begin early construction of Fayette Unit 3 prior to final agency action on the NPDES permit covering Fayette Unit 3;

THE UNITED STATES ENVIRONMNENTAL PROTECTION AGENCY, REGION 6 AND THE LOWER COLORADO RIVER AUTHORITY DO HEREBY AGREE TO THE FOLLOWING TERMS AND CONDITIONS:

1. That LCRA agrees to comply with all environmental impact statement (EIS) related requirements which may be contained in the NPDES permit for Fayette Power Project, Unit 3 (Fayette Unit 3).

2. That prior to the issuance of a NPDES permit which will cover Fayette Unit 3, if the Regional Administrator determines, on the basis of information submitted to EPA Region VI in connection with its review under the National Environmental Policy Act (NEPA), that any construction activity being conducted by LCRA at Fayette Unit 3 is causing or has the potential to cause significant or irreversible adverse environmental impact, LCRA agrees to cease any such construction activity for such period of time as may be necessary to allow LCRA and EPA Region VI to evaluate the effect of such activity in order to determine what actions, if any, should be taken to prevent or minimize any such adverse environmental impact.

3. That if LCRA shall then agree to take the actions determined to be necessary to prevent or minimize adverse environmental impact, LCRA may thereafter resume such construction activity.

4. That if LCRA shall not then agree to take the actions determined to be necessary to prevent or minimize adverse environmental impact, LCRA shall not resume such construction until it either agrees to take such actions or obtains a final determination pursuant to 40 C.F.R. 122 and 124 that such actions are not required.

5. That in connection with EPA review under NEPA, LCRA agrees that it will inform EPA Region VI of any construction activity being conducted by LCRA or its contractor at Fayette Unit 3 which has the potential to cause a significant or irreversible adverse environmental impact.

6. That if, during the construction of Fayette Unit 3, LCRA identifies any properties having potential cultural or historical value, LCRA agrees that it will notify EPA thereof and will preserve each such property, until a determination can be made if such property is eligible for listing in the National Register of Historic Places.

7. That LCRA does not hereby waive its rights pursuant to 40 C.F.R. 124 or otherwise to challenge hereafter any determination made by EPA Region VI pursuant to paragraph 1 of this Agreement.

8. That EPA does not hereby waive its rights pursuant to 40 C.F.R. 122.29(c)(5).

9. That, conditioned upon the foregoing agreements and compliance therewith by LCRA, the Regional Administrator, EPA, Region 6, grants permission to continue construction of Fayette Unit 3 prior to issuance of its final NPDES permit.

10. That LCRA is proceeding at its own risk by beginning construction of Unit 3 before issuance of a final NPDES permit because entering into this written agreement neither binds nor in any other way causes or requires EPA to issue an NPDES permit.

11. That the Agreement hereby provided for shall be in full force and effect from and after the date of signature of the Regional Administrator of Region VI.

LOWER COLORADO RIVER AUTHORITY

By Elof Soderberg
Elof Soderberg
General Manager

Date 6-26-84

By
Thomas Sedberry
Attorney for Permittee

Date 6-26-84

UNITED STATES ENVIRONMENTAL
PROTECTION AGENCY, REGION VI

By Dick Whittington
Dick Whittington, P.E.
Regional Administrator

Date June 21, 1984

By Patrick A. Hudson
Patrick Hudson
Attorney for Region 6

Date June 28, 1984

Permit No. TX0095591
Application No. TX0095591

AUTHORIZATION TO DISCHARGE UNDER THE NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM

Draft

In compliance with the provisions of the Federal Water Pollution Control Act, as amended, (33 U.S.C. 1251 et. seq; the "Act"),

Lower Colorado River Authority
P.O. Box 220
Austin, Texas 78767

is authorized to discharge from a facility located at Cummins Creek Mine, Fayette County, Texas

to receiving waters named Rabbs Creek and Cummins Creek and thence to the Colorado River

in accordance with effluent limitations, monitoring requirements and other conditions set forth in Parts I, II, and III hereof.

This permit shall become effective on

This permit and the authorization to discharge shall expire at midnight,

Signed this day of

Myron O. Knudson, P.E.
Director, Water Management Division (6W)

Draft

PART I
REQUIREMENTS FOR NPDES PERMITS

SECTION A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS - Outfalls 001-009

During the period beginning effective date and lasting through the expiration date the permittee is authorized to discharge from Outfall(s) serial number(s) 001-009, intermittent discharges from sedimentation ponds or pipe.

Such discharges shall be limited and monitored by the permittee as specified below:

Effluent Characteristic	Discharge Limitations			
	kg/day(lbs/day)		Other Units (Specify)	
	Daily Avg	Daily Max	Daily Avg	Daily Max
Flow-m^3/Day(MGD)	N/A	N/A	(*)	(*)
Total Suspended Solids	N/A	N/A	35.0 mg/l	70.0 mg/l
Total Iron	N/A	N/A	3.0 mg/l	6.0 mg/l
Total Manganese	N/A	N/A	2.0	4.0 mg/l

Effluent Characteristic	Monitoring Requirements	
	Measurement Frequency	Sample Type
Flow-m^3/Day(MGD)	1/Day**	Estimate***
Total Suspended Solids	1/Day**	Grab
Total Iron	1/Day**	Grab
Total Manganese	1/Day**	Grab

* Report.
** When discharging occurs.
*** See Part III, Paragraph C.

The pH shall not be less than 6.0 standard units nor greater than 9.0 standard units and shall be monitored 1/Day** by grab sample.

There shall be no discharge of floating solids or visible foam in other than trace amounts.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s): At the discharge points from the sedimentation ponds or pipe.

SECTION B. SCHEDULE OF COMPLIANCE

The permittee shall achieve compliance with the effluent limitations specified for discharges in accordance with the following schedule:

NONE

PART II
STANDARD CONDITIONS FOR NPDES PERMITS

SECTION A. GENERAL CONDITIONS

1. Duty to Comply

The permittee must comply with all conditions of this permit. Any permit noncompliance constitutes a violation of the Clean Water Act and is grounds for enforcement action; for permit termination, revocation and reissuance, or modification; or for denial of a permit renewal application.

2. Penalties for Violations of Permit Conditions

The Clean Water Act provides that any person who violates a permit condition implementing Sections 301, 302, 306, 307, 308, 318, or 405 of the Clean Water Act is subject to a civil penalty not to exceed $10,000 per day of such violation. Any person who willfully or negligently violates permit conditions inplementing Sections 301, 302, 306, 307, or 308 of the Clean Water Act is subject to a fine of not less than $2,500 nor more than $25,000 per day of violation, or by imprisonment for not more than 1 year, or both.

3. Permit Actions

This permit may be modified, revoked and reissued, or terminated for cause including, but not limited to, the following:

a. Violation of any terms or conditions of this permit;

b. Obtaining this permit by misrepresentation or failure to disclose fully all relevant facts; or

c. A change in any condition that requires either a temporary or a permanent reduction or elimination of the authorized discharge; or

d. A determination that the permitted activity endangers human health or the environment and can only be regulated to acceptable levels by permit modification or termination.

The filing of a request by the permittee for a permit modification, revocation and reissuance, or termination, or a notification of planned changes or anticipated noncompliance, does not stay any permit condition.

4. Toxic Pollutants

Notwithstanding Section A, paragraph 3 above, if any toxic effluent standard or prohibition (including any schedule of compliance specified in such effluent standard or prohibition) is promulgated under Section 307(a) of the Clean Water Act for a toxic pollutant which is present in the discharge and that standard or prohibition is more stringent than any limitation on the pollutant in this permit, this permit shall be modified or revoked and reissued to conform to the toxic effluent standard or prohibition and the permittee so notified.

The permittee shall comply with effluent standards or prohibitions established under Section 307(a) of the Clean Water Act for toxic pollutants within the time provided in the regulations that established those standards or prohibitions, even if the permit has not yet been modified to incorporate the requirement.

5. Civil and Criminal Liability

Except as provided in permit conditions on "Bypassing" Section B, paragraph 4.b. and "Upsets" Section B, paragraph 5.b., nothing in this permit shall be construed to relieve the permittee from civil or criminal penalties for noncompliance.

6. Oil and Hazardous Substance Liability

Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties to which the permittee is or may be subject under Section 311 of the Clean Water Act.

7. State Laws

Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties established pursuant to any applicable State law or regulation under authority preserved by Section 510 of the Clean Water Act.

8. Property Rights

The issuance of this permit does not convey any property rights of any sort, or any exclusive privileges, nor does it authorize any injury to private property or any invasion of personal rights, nor any infringement of Federal, State, or local laws or regulations.

9. Severability

The provisions of this permit are severable, and if any provision of this permit or the application of any provision of this permit to any circumstance is held invalid, the application of such provision to other circumstances, and the remainder of this permit, shall not be affected thereby.

10. Definitions

The following definitions shall apply unless otherwise specified in this permit:

a. "Daily Discharge" means the discharge of a pollutant measured during a calendar day or any 24-hour period that reasonably represents the calendar day for purposes of sampling. For pollutants with limitations expressed in terms of mass, the "daily discharge" is calculated as the total mass of the pollutant discharged over the sampling day. For pollutants with limitations expressed in other units of measurement, the "daily discharge" is calculated as the average measurement of the pollutant over the sampling day. "Daily discharge" determination of concentration made using a composite sample shall be the concentration of the composite sample. When grab samples are used, the "daily discharge" determination of concentration shall be the arithmetic average (weighted by flow value) of all samples collected during that sampling day.

b. "Daily Average" discharge limitation means the highest allowable average of "daily discharges" over a calendar month, calculated as the sum of all "daily discharges" measured during a calendar month divided by the number of "daily discharges" measured during that month.

c. "Daily Maximum" discharge limitation means the highest allowable "daily discharge" during the calendar month.

SECTION B. OPERATION AND MAINTENANCE OF POLLUTION CONTROLS

1. Proper Operation and Maintenance

The permittee shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used by the permittee to achieve compliance with the conditions of this permit. Proper operation and maintenance also includes adequate laboratory controls and appropriate quality assurance procedures. This provision requires the operation of backup or auxiliary facilities or similar systems which are installed by a permittee only when the operation is necessary to achieve compliance with the conditions of the permit.

2. Need to Halt or Reduce not a Defense

It shall not be a defense for a permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this permit.

3. Duty to Mitigate

The permittee shall take all reasonable steps to minimize or prevent any discharge in violation of this permit which has a reasonable likelihood of adversely affecting human health or the environment.

4. Bypass of Treatment Facilities

a. Definitions

(1) "Bypass" means the intentional diversion of waste streams from any portion of a treatment facility.

(2) "Severe property damage" means substantial physical damage to property, damage to the treatment facilities which causes them to become inoperable, or substantial and permanent loss of natural resources which can reasonably be expected to occur in the absence of a bypass. Severe property damage does not mean economic loss caused by delays in production.

b. Bypass not exceeding limitations. The permittee may allow any bypass to occur which does not cause effluent limitations to be exceeded, but only if it also is for essential maintenance to assure efficient operation. These bypasses are not subject to the provisions of Section B, paragraphs 4.c. and 4.d. of this section.

c. Notice

(1) Anticipated bypass. If the permittee knows in advance of the need for a bypass, it shall submit prior notice, if possible at least ten days before the date of the bypass.

(2) Unanticipated bypass. The permittee shall submit notice of an unanticipated bypass as required in Section D, paragraph 6 (24-hour notice).

d. Prohibition of bypass.

(1) Bypass is prohibited, and the Director may take enforcement action against a permittee for bypass, unless:

(a) Bypass was unavoidable to prevent loss of life, personal injury, or severe property damage;

(b) There were no feasible alternatives to the bypass, such as the use of auxiliary treatment facilities, retention of untreated wastes, or maintenance during normal periods of equipment downtime. This condition is not satisfied if adequate back-up equipment should have been installed in the exercise of reasonable engineering judgment to prevent a bypass which occured during normal periods of equipment downtime or preventive maintenance; and

(c) The permittee submitted notices as required under Section B, paragraph 4.c.

(2) The Director may approve an anticipated bypass, after considering its adverse effects, if the Director determines that it will meet the three conditions listed above in Section B, paragraph 4.d.(1).

5. Upset Conditions

a. Definition. "Upset" means an exceptional incident in which there is unintentional and temporary noncompliance with technology-based permit effluent limitations because of factors beyond the reasonable control of the permittee. An upset does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventive maintenance, or careless or improper operation.

b. Effect of an upset. An upset constitutes an affirmative defense to an action brought for noncompliance with such technology-based permit effluent limitations if the requirements of Section B, paragraph 5.c. are met. No determination made during administrative review of claims that noncompliance was caused by upset, and before an action for noncompliance, is final administrative action subject to judicial review.

c. Conditions necessary for a demonstration of upset. A permittee who wishes to establish the affirmative defense of upset shall demonstrate, through properly signed, contemporaneous operating logs, or other relevant evidence that:

(1) An upset occurred and that the permittee can identify the cause(s) of the upset;

(2) The permitted facility was at the time being properly operated; and

(3) The permittee submitted notice of the upset as required in Section D, paragraph 6.

(4) The permittee complied with any remedial measures required under Section B, paragraph 3.

d. Burden of proof. In any enforcement proceeding the permittee seeking to establish the occurrence of an upset has the burden of proof.

6. Removed Substances

Solids, sludges, filter backwash, or other pollutants removed in the course of treatment or control of wastewaters shall be disposed of in a manner such as to prevent any pollutant from such materials from entering navigable waters.

SECTION C. MONITORING AND RECORDS

1. Representative Sampling

Samples and measurements taken as required herein shall be representative of the volume and nature of the monitored dishcarge. All samples shall be taken at the monitoring points specified in this permit and, unless otherwise specified, before the effluent joins or is diluted by any other wastestream, body of water, or substance. Monitoring points shall not be changed without notification to and the approval of the Director.

2. Flow Measurements

Appropriate flow measurement devices and methods consistent with accepted scientific practices shall be selected and used to ensure the accuracy and reliability of measurements of the volume of monitored discharges. The devices shall be installed, calibrated, and maintained to insure that the accuracy of the measurements are consistent with the accepted capability of that type of device. Devices selected shall be capable of measuring flows with a maximum deviation of less than ± 10% from true discharge rates throughout the range of expected discharge volumes. Guidance in selection, installation, calibration, and operation of acceptable flow measurement devices can be obtained from the following references:

a. "A Guide to Methods and Standards for the Measurement of Water Flow", U.S. Department of Commerce, National Bureau of Standards, NBS Special Publication 421, May 1975, 97 pp. (Available from the U.S. Government Printing Office, Washington, D.C. 20402. Order by SD catalog No. C13.10:421).

b. "Water Measurement Manual", U.S. Department of Interior, Bureau of Reclamation, Second Edition, Revised Reprint, 1974, 327 pp. (Available from the U.S. Government Printing Office, Washington, D.C. 20402. Order by Catalog No. 127.19/2:W29/2, Stock No. S/N 24003-0027).

c. "Flow Measurement in Open Channels and Closed Conduits", U.S. Department of Commerce, National Bureau of Standards, NBS Special Publication 484, October 1977, 982 pp. (Available in paper copy or microfiche from National Technical Information Service (NTIS), Springfield, VA 22151. Order by NTIS No. PB-273 535/5ST).

d. "NPDES Compliance Sampling Manual", U.S. Environmental Protection Agency, Office of Water Enforcement, Publication

MCD-51, 1977, 140 pp. (Available from the General Services Administration [8FFS], Centralized Mailing Lists Services, Building 41, Denver Federal Center, Denver, CO 80225).

3. Monitoring Procedures

Monitoring must be conducted according to test procedures approved under 40 CFR Part 136, unless other test procedures have been specified in this permit.

4. Penalties for Tampering

The Clean Water Act provides that any person who falsifies, tampers with, or knowingly renders inaccurate, any monitoring device or method required to be maintained under this permit shall, upon conviction, be punished by a fine of not more than $10,000 per violation, or by imprisonment for not more than 6 months per violation, or by both.

5. Reporting of Monitoring Results

Monitoring results must be reported on a Discharge Monitoring Report (DMR) form (EPA No. 3320-1). Monitoring results obtained during the previous 3 months shall be summarized and reported on a DMR form postmarked no later than the __________ day of the month following the completed reporting period. The first report is due ____________ Duplicate copies of DMR's signed and certified as required by Section D, paragraph 11, and all other reports required by Section D. Reporting Requirements, shall be submitted to the Director and to the State (if listed) at the following address(es):

Director
Water Management Division (6W)
U.S. Environmental Protection Agency
Region VI
InterFirst Two Building
Dallas, Texas 75270

6. Additional Monitoring by the Permittee

If the permittee monitors any pollutant more frequently than required by this permit, using test procedures approved under 40 CFR Part 136 or as specified in this permit, the results of this monitoring shall be included in the calculation and reporting of the data submitted in the DMR. Such increased monitoring frequency shall also be indicated on the DMR.

7. Averaging of Measurements

Calculations for all limitations which require averaging of measurements shall utilize an arithmetic mean unless otherwise specified by the Director in the permit.

8. Retention of Records

The permittee shall retain records of all monitoring information, including all calibration and maintenance records and all original strip chart recordings for continuous monitoring instrumentation, copies of all reports required by this permit, and records of all data used to complete the application for this permit, for a period of at least 3 years from the date of the sample, measurement, report, or application. This period may be extended by request of the Director at any time.

9. Record Contents

Records of monitoring information shall include:

a. The date, exact place, and time of sampling or measurements;

b. The individual(s) who performed the sampling or measurements;

c. The date(s) analyses were performed;

d. The individual(s) who performed the analyses;

e. The analytical techniques or methods used; and

f. The results of such analyses.

10. Inspection and Entry

The permittee shall allow the Director, or an authorized representative, upon the presentation of credentials and other documents as may be required by law, to:

a. Enter upon the permittee's premises where a regulated facility or activity is located or conducted, or where records must be kept under the conditions of this permit;

b. Have access to and copy, at reasonable times, any records that must be kept under the conditions of this permit;

c. Inspect at reasonable times any facilities, equipment (including monitoring and control equipment), practices, or operations regulated or required under this permit; and

d. Sample or monitor at reasonable times, for the purposes of assuring permit compliance or as otherwise authorized by the Clean Water Act, any substances or parameters at any location.

SECTION D. REPORTING REQUIREMENTS

1. Planned Changes

The permittee shall give notice to the Director as soon as possible of any planned physical alterations or additions to the permitted facility. Notice is required only when:

a. The alteration or addition to a permitted facility may meet one of the criteria for determining whether a facility is a new source in 40 CFR Part 122.29(b) [48 FR 14153, April 1, 1983, as amended at 49 FR 38046, September 26, 1984]; or

b. The alteration or addition could significantly change the nature or increase the quantity of pollutants discharged. This notification applies to pollutants which are subject neither to effluent limitations in the permit, nor to notification requirements under 40 CFR Part 122.42(a)(1) [48 FR 14153, April 1,1983, as amended at 49 FR 38046, September 26, 1984].

2. Anticipated Noncompliance

The permittee shall give advance notice to the Director of any planned changes in the permitted facility or activity which may result in noncompliance with permit requirements.

3. Transfers

This permit is not transferable to any person except after notice to the Director. The Director may require modification or revocation and reissuance of the permit to change the name of the permittee and incorporate such other requirements as may be necessary under the Clean Water Act.

4. Monitoring Reports

Monitoring results shall be reported at the intervals and in the form specified in Section C, paragraph 5 (Monitoring).

5. Compliance Schedules

Reports of compliance or noncompliance with, or any progress reports on, interim and final requirements contained in any compliance schedule of this permit shall be submitted no later than 14 days following each schedule date. Any reports of noncompliance shall include the cause of noncompliance, any remedial actions taken, and the probability of meeting the next scheduled requirement.

6. Twenty Four Hour Reporting

The permittee shall report any noncompliance which may endanger health or the environment. Any information shall be provided orally within 24 hours from the time the permittee becomes aware of the circumstances. A written submission shall also be provided within 5 days of the time the permittee becomes aware of the circumstances. The written submission shall contain a description of the noncompliance and its cause; the period of noncompliance, including exact dates and times, and if the noncompliance has not been corrected, the anticipated time it is expected to continue; and steps taken or planned to reduce, eliminate, and prevent reoccurrence of the noncompliance. The Director may waive the written report on a case-by-case basis if the oral report has been received within 24 hours.

The following shall be included as information which must be reported within 24 hours:

a. Any unanticipated bypass which exceeds any effluent limitation in the permit.

b. Any upset which exceeds any effluent limitation in the permit.

c. Violation of a maximum daily discharge limitation for any of the pollutants listed by the Director in Part III of the permit to be reported within 24 hours.

7. Other Noncompliance

The permittee shall report all instances of noncompliance not reported under Section D, paragraphs 4, 5, and 6, at the time monitoring reports are submitted. The reports shall contain the information listed in Section D, paragraph 6.

8. Changes in Discharges of Toxic Substances

The permittee shall notify the Director as soon as it knows or has reason to believe:

a. That any activity has occured or will occur which would result in the discharge, in a routine or frequent basis, of any toxic pollutant which is not limited in the permit, if that discharge will exceed the highest of the "notification levels" described in 40 CFR Part 122.42(a)(1) [48 FR 14153, April 1, 1983, as amended at 49 FR 38046, September 26, 1984].

b. That any activity has occured or will occur which would result in any discharge, on a non-routine or infrequent basis, of a toxic pollutant which is not limited in the permit, if that discharge will exceed the highest of the "notification levels" described in 40 CFR Part 122.42(a)(2) [48 FR 14153, April 1,1983, as amended at 49 FR 38046, September 26, 1984).

9. Duty to Provide Information

The permittee shall furnish to the Director, within a reasonable time, any information which the Director may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this permit, or to determine compliance with this permit. The permittee shall also furnish to the Director, upon request, copies of records required to be kept by this permit.

10. Duty to Reapply

If the permittee wishes to continue an activity regulated by this permit after the expiration date of this permit, the permittee must apply for and obtain a new permit. The application shall be submitted at least 180 days before the expiration date of this permit. The Director may grant permission to submit an application less than 180 days in advance but no later than the permit expiration date.

11. Signatory Requirements

All applications, reports, or information submitted to the Director shall be signed and certified.

a. All permit applications shall be signed as follows:

(1) For a corporation: by a responsible corporate officer. For the purpose of this section, a responsible corporate officer means:

(i) A president, secretary, treasurer, or vice-president of the corporation in charge of a principal business function, or any other person who performs similar policy or decision making functions for the corporation, or

(ii) the manager of one or more manufacturing, production, or operating facilities employing more than 250 persons or having gross annual sales or expenditures exceeding $25 million (in second-quarter 1980 dollars), if authority to sign documents has been assigned or delegated to the manager in accordance with corporate procedures.

(2) For a partnership or sole proprietorship: by a general partner or the proprietor, respectively.

(3) For a municipality, State, Federal, or other public agency: by either a principal executive officer or ranking elected official. For purposes of this section, a principal executive officer of a Federal agency includes:

(i) The chief executive officer of the agency, or

(ii) a senior executive officer having responsibility for the overall operations of a principal geographic unit of the agency.

b. All reports required by the permit and other information requested by the Director shall be signed by a person described above or by a duly authorized representative of that person. A person is a duly authorized representative only if:

(1) The authorization is made in writing by a person described above.

(2) The authorization specifies either an individual or a position having responsibility for the overall operation of the regulated facility or activity, such as the position of plant manager, operator of a well or a well field, superintendent, or position of equivalent responsibility, or an individual or position having overall responsibility for environmental matters for the company. A duly authorized representative may thus be either a named individual or any individual occupying a named position; and

(3) The written authorization is submitted to the Director.

c. Certification. Any person signing a document under this section shall make the following certification:

"I certify under penalty of law that this document and all attachments were prepared under the direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

12. Availability of Reports

Except for data determined to be confidential under 40 CFR Part 2, all reports prepared in accordance with the terms of this permit shall be available for public inspection at the office of the Director. As required by the Clean Water Act, the name and address of any permit applicant or permittee, permit applications, permits, and effluent data shall not be considered confidential.

13. Penalties for Falsification of Reports

The Clean Water Act provides that any person who knowingly makes any false statement, representation, or certification in any record or other document submitted or required to be maintained under this permit, including monitoring reports or reports of compliance or noncompliance shall, upon conviction, be punished by a fine of not more than $10,000 per violation, or by imprisonment for not more than 6 months per violation, or by both.

PART III
OTHER CONDITIONS

A. Effluent Limitations for Reclamation Areas

The following standards apply to discharges from reclamation areas until SMCRA bond release:

Effluent Limitations

Pollutant or Pollutant Property	Maximum for any one day	Average of daily values for thirty consecutive days
Settleable Solids	0.5 ml/l	N/A
pH	Within the range 6.0 to 9.0 at all times	

B. Determination of Settleable Solids

The following procedure shall be used to determine settleable solids:

Fill an Imhoff cone to the one-liter mark with a thoroughly mixed sample. Allow to settle undisturbed for 45 minutes. Gently stir along the inside surface of the cone with a stirring rod. Allow to settle undisturbed for 15 minutes longer. Record the volume of settled material in the cones as milliliters per liter. Where a separation of settleable and floating materials occurs, do not include the floating material in the reading.

The method detection limit for measuring settleable solids shall be 0.4 ml/l.

C. Methods of flow estimating shall be by the "California Pipe Method" as described in section 7.4.2.2. of the Handbook for Monitoring Industrial Wastewater, August 1973, U.S. Environmental Protection Agency, Technology Transfer.

D. Initial Discharge Locations

Discharge Serial No.	Discharge Name	Receiving Waters	Latitude	Longitude
001	SP-1	Rabbs Creek	30°06'20"N	96°49'09"W
002	SP-2	Rabbs Creek	30°03'36"N	96°50'57"W
003	SP-5	Rabbs Creek	30°05'26"N	96°49'54"W
004	SP-6C	Cummins Creek	30°05'14"N	96°46'46"W
005	Support Facility Pond	Cummins Creek	30°04'25"N	96°48'36"W
006	SP-9	Cummins Creek	30°04'24"N	96°04'24"W
007	SP-10	Cummins Creek	30°05'56"N	96°45'48"W
008	SP-2	Rabb Creek	30°03'28"N	96°50'15"W
009	GW-1	Cummins Creek	30°04'51"N	96°46'42"W

PART III
OTHER CONDITIONS

E. Locations may be revised by the permittee if it becomes necessary to eliminate or establish new holding ponds. For any revision the permittee shall submit appropriate maps redesignating the holding pond location.

Any revised pond or outfall location should be consistent with and fall within the mining area boundary as defined in the applicant's State Mining Plan.

Any revised pond or outfall location shall be limited to discharging to the same receiving body of water.

Permit No. TX0073121
Application No. TX0073121

Draft

AUTHORIZATION TO DISCHARGE UNDER THE NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM

In compliance with the provisions of the Federal Water Pollution Control Act, as amended, (33 U.S.C. 1251 et. seq; the "Act"),

Lower Colorado River Authority
P.O. Box 220
Austin, Texas 78767

is authorized to discharge from a facility located at

Units 1, 2, 3 and 4
Fayette Power Project
La Grange, Fayette County, Texas

to receiving waters named Cedar Creek and thence to the Colorado River

in accordance with effluent limitations, monitoring requirements and other conditions set forth in Parts I, II, and III hereof.

This permit shall become effective on

This permit and the authorization to discharge shall expire at midnight,

Signed this day of

Myron O. Knudson, P.E.
Director, Water Management Division (6W)

Draft

PART I
REQUIREMENTS FOR NPDES PERMITS

SECTION A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS - Outfall 001

During the period beginning effective date and lasting through expiration date the permittee is authorized to discharge from Outfall(s) serial number(s) 001 reservoir blowdown. Such discharges shall be limited and monitored by the permittee as specified below:

Effluent Characteristic	Discharge Limitations			
	kg/day(lbs/day)		Other Units (Specify)	
	Daily Avg	Daily Max	Daily Avg	Daily Max
Flow-m^3/Day(MGD)	N/A	N/A	(*)	(*)
Temperature, degrees	N/A	N/A	*°C(°F)***	35.0°C(95°F)**

Effluent Characteristic	Monitoring Requirements	
	Measurement Frequency	Sample Type
Flow-m^3/Day(MGD)	Continuous	Record
Temperature, degrees	Continuous	Record

* Report
** Instantaneous Maximum
*** See Part III, Paragraph C.

The pH shall not be less than 6.0 standard units nor greater than 9.0 standard units and shall be monitored 1/week by grab sample.

There shall be no discharge of floating solids or visible foam in other than trace amounts.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s): At Outfall 001 where Cedar Creek reservoir discharges from a 9 foot diameter conduit to Cedar Creek.

PART I
REQUIREMENTS FOR NPDES PERMITS

SECTION A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS - Outfall 101

During the period beginning effective date and lasting through expiration date the permittee is authorized to discharge from Outfall(s) serial number(s) 101 recirculating cooling water from Units 1, 2, 3 and 4. Such discharges shall be limited and monitored by the permittee as specified below:

Effluent Characteristic	Discharge Limitations			
	kg/day(lbs/day)		Other Units (Specify)	
	Daily Avg	Daily Max	Daily Avg	Daily Max
Flow-m^3/Day(MGD)	N/A	N/A	(*)	(*)
Temperature, degrees	N/A	N/A	*°C(*F)	*°C(*F)
Total Residual Chlorine**	N/A	95(210)	N/A	0.2 mg/l

Effluent Characteristic	Monitoring Requirements	
	Measurement Frequency	Sample Type
Flow-m^3/Day(MGD)	1/day	Calculated
Temperature, degrees	1/day	In Situ
Total Residual Chlorine	1/week***	Grab

* Report
** See Part III, Paragraph F.
*** Samples shall be representative of periods of chlorination.

The pH shall not be less than N/A standard units nor greater than N/A standard units and shall be monitored N/A.

There shall be no discharge of floating solids or visible foam in other than trace amounts.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s): At Outfall 101 where recirculating cooling water discharges from the canal into Cedar Creek Reservoir.

PART I
REQUIREMENTS FOR NPDES PERMITS

SECTION A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS - Outfall 201

During the period beginning effective date and lasting through expiration date the permittee is authorized to discharge from Outfall(s) serial number(s) 201, intermittent flow, low-volume wastewater*. Such discharges shall be limited and monitored by the permittee as specified below:

Effluent Characteristic	Discharge Limitations			
	kg/day(lbs/day)		Other Units (Specify)	
	Daily Avg	Daily Max	Daily Avg	Daily Max
Flow-m^3/Day(MGD)	N/A	N/A	Report	Report
Total Suspended Solids	N/A	N/A	30 mg/l	100 mg/l
Oil and Grease	N/A	N/A	15 mg/l	20 mg/l

Effluent Characteristic	Monitoring Requirements	
	Measurement Frequency	Sample Type
Flow-m^3/Day(MGD)	1/day	Estimate
Total Suspended Solids	1/week	Grab
Oil and Grease	1/week	Grab

* See Part III, Paragraph D.

The pH shall not be less than 6.0 standard units nor greater than 9.0 standard units and shall be monitored 1/week by grab sample.

There shall be no discharge of floating solids or visible foam in other than trace amounts.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s): At Outfall 201 where low volume wastewater is discharged from the low volume waste treatment facility prior to mixing with the once-through cooling water.

PART I
REQUIREMENTS FOR NPDES PERMITS

SECTION A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS - Outfall 301

During the period beginning effective date and lasting through expiration date the permittee is authorized to discharge from Outfall(s) serial number(s) 301, treated sanitary wastewater (3STP's). Such discharges shall be limited and monitored by the permittee as specified below:

Effluent Characteristic	Discharge Limitations			
	kg/day(lbs/day)		Other Units (Specify)	
	Daily Avg	Daily Max	Daily Avg	Daily Max
Flow-m^3/Day(MGD)	N/A	N/A	(*)	(*)
Total Suspended Solids	N/A	N/A	20 mg/l	45 mg/l
Biochemical Oxygen Demand (5 day)	N/A	N/A	20 mg/l	45 mg/l

Effluent Characteristic	Monitoring Requirements	
	Measurement Frequency	Sample Type
Flow-m^3/Day(MGD)	1/day	Estimate
Total Suspended Solids	1/week	Grab**
Biochemical Oxygen Demand (5 day)	1/week	Grab**

The sanitary wastewater stream shall be chlorinated sufficiently to maintain a 1.0 mg/l chlorine residual after at least 20 minutes contact time (based on peak flow) prior to mixing with any other wastewater.

* Report. Total flow of all sewage treatment plants.

** Since more than one source is associated with this particular waste category, grab samples from each source shall be combined into a single flow weighted sample for analysis and reporting.

The pH shall not be less than 6.0 standard units nor greater than 9.0 standard units and shall be monitored 1/week by grab sample.

There shall be no discharge of floating solids or visible foam in other than trace amounts.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s): At Outfall 301, where treated effluent is discharged from the treatment facility prior to mixing with any other waters.

PART I
REQUIREMENTS FOR NPDES PERMITS

SECTION A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS - Outfall 002

During the period beginning effective date and lasting through expiration date the permittee is authorized to discharge from Outfall(s) serial number(s) 002, oily waste treatment from Units 1, 2, 3 and 4. Such discharges shall be limited and monitored by the permittee as specified below:

Effluent Characteristic	Discharge Limitations			
	kg/day(lbs/day)		Other Units (Specify)	
	Daily Avg	Daily Max	Daily Avg	Daily Max
Flow-m^3/Day(MGD)	N/A	N/A	(*)	N/A
Total Suspended Solids	N/A	N/A	30 mg/l	100 mg/l
Oil and Grease	N/A	N/A	15 mg/l	20 mg/l

Effluent Characteristic	Monitoring Requirements	
	Measurement Frequency	Sample Type
Flow-m^3/Day(MGD)	1/day	Estimate
Total Supended Solids	1/week	Grab
Oil and Grease	1/week	Grab

* Report

The pH shall not be less than 6.0 standard units nor greater than 9.0 standard units and shall be monitored 1/week by grab sample.

There shall be no discharge of floating solids or visible foam in other than trace amounts.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s): At Outfall 002 where low volume wastewater is discharged from the low volume waste treatment facility prior to mixing with any otehr waste stream.

PART I
REQUIREMENTS FOR NPDES PERMITS

SECTION A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS - Outfall 003

During the period beginning effective date and lasting through expiration date the permittee is authorized to discharge from Outfall(s) serial number(s) 003, coal pile rainfall runoff. Such discharges shall be limited and monitored by the permittee as specified below:

Effluent Characteristic	Discharge Limitations			
	kg/day(lbs/day)		Other Units (Specify)	
	Daily Avg	Daily Max	Daily Avg	Daily Max
Flow-m^3/Day(MGD)	N/A	N/A	(*)	N/A
Total Suspended Solids	N/A	N/A	N/A	50 mg/l

Effluent Characteristic	Monitoring Requirements	
	Measurement Frequency	Sample Type
Flow-m^3/Day(MGD)	1/occurrence**	Estimate
Total Suspended Solids	1/occurrence**	Grab

* Report

** Samples shall be taken once during each occurrence or once every 24 hours if duration of occurrence is greater than 24 hours.

The pH shall not be less than 6.0 standard units nor greater than 9.0 standard units and shall be monitored 1/occurrence*** by grab sample.

There shall be no discharge of floating solids or visible foam in other than trace amounts.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s): At Outfall 003 where area runoff water is discharged from the coal storage runoff retention pond prior to mixing with any other waste stream and prior to entry to Cedar Creek.

SECTION B. SCHEDULE OF COMPLIANCE

The permittee shall achieve compliance with the effluent limitations specified for discharges in accordance with the following schedule:

None

PART II
STANDARD CONDITIONS FOR NPDES PERMITS

SECTION A. GENERAL CONDITIONS

1. Duty to Comply

The permittee must comply with all conditions of this permit. Any permit noncompliance constitutes a violation of the Clean Water Act and is grounds for enforcement action; for permit termination, revocation and reissuance, or modification; or for denial of a permit renewal application.

2. Penalties for Violations of Permit Conditions

The Clean Water Act provides that any person who violates a permit condition implementing Sections 301, 302, 306, 307, 308, 318, or 405 of the Clean Water Act is subject to a civil penalty not to exceed $10,000 per day of such violation. Any person who willfully or negligently violates permit conditions inplementing Sections 301, 302, 306, 307, or 308 of the Clean Water Act is subject to a fine of not less than $2,500 nor more than $25,000 per day of violation, or by imprisonment for not more than 1 year, or both.

3. Permit Actions

This permit may be modified, revoked and reissued, or terminated for cause including, but not limited to, the following:

a. Violation of any terms or conditions of this permit;

b. Obtaining this permit by misrepresentation or failure to disclose fully all relevant facts; or

c. A change in any condition that requires either a temporary or a permanent reduction or elimination of the authorized discharge; or

d. A determination that the permitted activity endangers human health or the environment and can only be regulated to acceptable levels by permit modification or termination.

The filing of a request by the permittee for a permit modification, revocation and reissuance, or termination, or a notification of planned changes or anticipated noncompliance, does not stay any permit condition.

4. Toxic Pollutants

Notwithstanding Section A, paragraph 3 above, if any toxic effluent standard or prohibition (including any schedule of compliance specified in such effluent standard or prohibition) is promulgated under Section 307(a) of the Clean Water Act for a toxic pollutant which is present in the discharge and that standard or prohibition is more stringent than any limitation on the pollutant in this permit, this permit shall be modified or revoked and reissued to conform to the toxic effluent standard or prohibition and the permittee so notified.

The permittee shall comply with effluent standards or prohibitions established under Section 307(a) of the Clean Water Act for toxic pollutants within the time provided in the regulations that established those standards or prohibitions, even if the permit has not yet been modified to incorporate the requirement.

5. Civil and Criminal Liability

Except as provided in permit conditions on "Bypassing" Section B, paragraph 4.b. and "Upsets" Section B, paragraph 5.b., nothing in this permit shall be construed to relieve the permittee from civil or criminal penalties for noncompliance.

6. Oil and Hazardous Substance Liability

Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties to which the permittee is or may be subject under Section 311 of the Clean Water Act.

7. State Laws

Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties established pursuant to any applicable State law or regulation under authority preserved by Section 510 of the Clean Water Act.

8. Property Rights

The issuance of this permit does not convey any property rights of any sort, or any exclusive privileges, nor does it authorize any injury to private property or any invasion of personal rights, nor any infringement of Federal, State, or local laws or regulations.

9. Severability

The provisions of this permit are severable, and if any provision of this permit or the application of any provision of this permit to any circumstance is held invalid, the application of such provision to other circumstances, and the remainder of this permit, shall not be affected thereby.

10. Definitions

The following definitions shall apply unless otherwise specified in this permit:

a. "Daily Discharge" means the discharge of a pollutant measured during a calendar day or any 24-hour period that reasonably represents the calendar day for purposes of sampling. For pollutants with limitations expressed in terms of mass, the "daily discharge" is calculated as the total mass of the pollutant discharged over the sampling day. For pollutants with limitations expressed in other units of measurement, the "daily discharge" is calculated as the average measurement of the pollutant over the sampling day. "Daily discharge" determination of concentration made using a composite sample shall be the concentration of the composite sample. When grab samples are used, the "daily discharge" determination of concentration shall be the arithmetic average (weighted by flow value) of all samples collected during that sampling day.

b. "Daily Average" discharge limitation means the highest allowable average of "daily discharges" over a calendar month, calculated as the sum of all "daily discharges" measured during a calendar month divided by the number of "daily discharges" measured during that month.

c. "Daily Maximum" discharge limitation means the highest allowable "daily discharge" during the calendar month.

SECTION B. OPERATION AND MAINTENANCE OF POLLUTION CONTROLS

1. Proper Operation and Maintenance

The permittee shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used by the permittee to achieve compliance with the conditions of this permit. Proper operation and maintenance also includes adequate laboratory controls and appropriate quality assurance procedures. This provision requires the operation of backup or auxiliary facilities or similar systems which are installed by a permittee only when the operation is necessary to achieve compliance with the conditions of the permit.

2. Need to Halt or Reduce not a Defense

It shall not be a defense for a permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this permit.

3. Duty to Mitigate

The permittee shall take all reasonable steps to minimize or prevent any discharge in violation of this permit which has a reasonable likelihood of adversely affecting human health or the environment.

4. Bypass of Treatment Facilities

a. Definitions

(1) "Bypass" means the intentional diversion of waste streams from any portion of a treatment facility.

(2) "Severe property damage" means substantial physical damage to property, damage to the treatment facilities which causes them to become inoperable, or substantial and permanent loss of natural resources which can reasonably be expected to occur in the absence of a bypass. Severe property damage does not mean economic loss caused by delays in production.

b. Bypass not exceeding limitations. The permittee may allow any bypass to occur which does not cause effluent limitations to be exceeded, but only if it also is for essential maintenance to assure efficient operation. These bypasses are not subject to the provisions of Section B, paragraphs 4.c. and 4.d. of this section.

c. Notice

(1) Anticipated bypass. If the permittee knows in advance of the need for a bypass, it shall submit prior notice, if possible at least ten days before the date of the bypass.

(2) Unanticipated bypass. The permittee shall submit notice of an unanticipated bypass as required in Section D, paragraph 6 (24-hour notice).

d. Prohibition of bypass.

(1) Bypass is prohibited, and the Director may take enforcement action against a permittee for bypass, unless:

(a) Bypass was unavoidable to prevent loss of life, personal injury, or severe property damage;

(b) There were no feasible alternatives to the bypass, such as the use of auxiliary treatment facilities, retention of untreated wastes, or maintenance during normal periods of equipment downtime. This condition is not satisfied if adequate back-up equipment should have been installed in the exercise of reasonable engineering judgment to prevent a bypass which occured during normal periods of equipment downtime or preventive maintenance; and

(c) The permittee submitted notices as required under Section B, paragraph 4.c.

(2) The Director may approve an anticipated bypass, after considering its adverse effects, if the Director determines that it will meet the three conditions listed above in Section B, paragraph 4.d.(1).

5. Upset Conditions

a. Definition. "Upset" means an exceptional incident in which there is unintentional and temporary noncompliance with technology-based permit effluent limitations because of factors beyond the reasonable control of the permittee. An upset does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventive maintenance, or careless or improper operation.

b. Effect of an upset. An upset constitutes an affirmative defense to an action brought for noncompliance with such technology-based permit effluent limitations if the requirements of Section B, paragraph 5.c. are met. No determination made during administrative review of claims that noncompliance was caused by upset, and before an action for noncompliance, is final administrative action subject to judicial review.

c. Conditions necessary for a demonstration of upset. A permittee who wishes to establish the affirmative defense of upset shall demonstrate, through properly signed, contemporaneous operating logs, or other relevant evidence that:

(1) An upset occurred and that the permittee can identify the cause(s) of the upset;

(2) The permitted facility was at the time being properly operated; and

(3) The permittee submitted notice of the upset as required in Section D, paragraph 6.

(4) The permittee complied with any remedial measures required under Section B, paragraph 3.

d. Burden of proof. In any enforcement proceeding the permittee seeking to establish the occurrence of an upset has the burden of proof.

6. Removed Substances

Solids, sludges, filter backwash, or other pollutants removed in the course of treatment or control of wastewaters shall be disposed of in a manner such as to prevent any pollutant from such materials from entering navigable waters.

SECTION C. MONITORING AND RECORDS

1. Representative Sampling

Samples and measurements taken as required herein shall be representative of the volume and nature of the monitored dishcarge. All samples shall be taken at the monitoring points specified in this permit and, unless otherwise specified, before the effluent joins or is diluted by any other wastestream, body of water, or substance. Monitoring points shall not be changed without notification to and the approval of the Director.

2. Flow Measurements

Appropriate flow measurement devices and methods consistent with accepted scientific practices shall be selected and used to ensure the accuracy and reliability of measurements of the volume of monitored discharges. The devices shall be installed, calibrated, and maintained to insure that the accuracy of the measurements are consistent with the accepted capability of that type of device. Devices selected shall be capable of measuring flows with a maximum deviation of less than ± 10% from true discharge rates throughout the range of expected discharge volumes. Guidance in selection, installation, calibration, and operation of acceptable flow measurement devices can be obtained from the following references:

a. "A Guide to Methods and Standards for the Measurement of Water Flow", U.S. Department of Commerce, National Bureau of Standards, NBS Special Publication 421, May 1975, 97 pp. (Available from the U.S. Government Printing Office, Washington, D.C. 20402. Order by SD catalog No. C13.10:421).

b. "Water Measurement Manual", U.S. Department of Interior, Bureau of Reclamation, Second Edition, Revised Reprint, 1974, 327 pp. (Available from the U.S. Government Printing Office, Washington, D.C. 20402. Order by Catalog No. I27.19/2:W29/2, Stock No. S/N 24003-0027).

c. "Flow Measurement in Open Channels and Closed Conduits", U.S. Department of Commerce, National Bureau of Standards, NBS Special Publication 484, October 1977, 982 pp. (Available in paper copy or microfiche from National Technical Information Service (NTIS), Springfield, VA 22151. Order by NTIS No. PB-273 535/5ST).

d. "NPDES Compliance Sampling Manual", U.S. Environmental Protection Agency, Office of Water Enforcement, Publication

MCD-51, 1977, 140 pp. (Available from the General Services Administration [8FFS], Centralized Mailing Lists Services, Building 41, Denver Federal Center, Denver, CO 80225).

3. Monitoring Procedures

Monitoring must be conducted according to test procedures approved under 40 CFR Part 136, unless other test procedures have been specified in this permit.

4. Penalties for Tampering

The Clean Water Act provides that any person who falsifies, tampers with, or knowingly renders inaccurate, any monitoring device or method required to be maintained under this permit shall, upon conviction, be punished by a fine of not more than $10,000 per violation, or by imprisonment for not more than 6 months per violation, or by both.

5. Reporting of Monitoring Results

Monitoring results must be reported on a Discharge Monitoring Report (DMR) form (EPA No. 3320-1). Monitoring results obtained during the previous 3 months shall be summarized and reported on a DMR form postmarked no later than the ________ day of the month following the completed reporting period. The first report is due ________. Duplicate copies of DMR's signed and certified as required by Section D, paragraph 11, and all other reports required by Section D. Reporting Requirements, shall be submitted to the Director and to the State (if listed) at the following address(es):

Director
Water Management Division (6W)
U.S. Environmental Protection Agency
Region VI
InterFirst Two Building
Dallas, Texas 75270

6. Additional Monitoring by the Permittee

If the permittee monitors any pollutant more frequently than required by this permit, using test procedures approved under 40 CFR Part 136 or as specified in this permit, the results of this monitoring shall be included in the calculation and reporting of the data submitted in the DMR. Such increased monitoring frequency shall also be indicated on the DMR.

7. Averaging of Measurements

Calculations for all limitations which require averaging of measurements shall utilize an arithmetic mean unless otherwise specified by the Director in the permit.

8. Retention of Records

The permittee shall retain records of all monitoring information, including all calibration and maintenance records and all original strip chart recordings for continuous monitoring instrumentation, copies of all reports required by this permit, and records of all data used to complete the application for this permit, for a period of at least 3 years from the date of the sample, measurement, report, or application. This period may be extended by request of the Director at any time.

9. Record Contents

Records of monitoring information shall include:

a. The date, exact place, and time of sampling or measurements;

b. The individual(s) who performed the sampling or measurements;

c. The date(s) analyses were performed;

d. The individual(s) who performed the analyses;

e. The analytical techniques or methods used; and

f. The results of such analyses.

10. Inspection and Entry

The permittee shall allow the Director, or an authorized representative, upon the presentation of credentials and other documents as may be required by law, to:

a. Enter upon the permittee's premises where a regulated facility or activity is located or conducted, or where records must be kept under the conditions of this permit;

b. Have access to and copy, at reasonable times, any records that must be kept under the conditions of this permit;

c. Inspect at reasonable times any facilities, equipment (including monitoring and control equipment), practices, or operations regulated or required under this permit; and

d. Sample or monitor at reasonable times, for the purposes of assuring permit compliance or as otherwise authorized by the Clean Water Act, any substances or parameters at any location.

SECTION D. REPORTING REQUIREMENTS

1. Planned Changes

The permittee shall give notice to the Director as soon as possible of any planned physical alterations or additions to the permitted facility. Notice is required only when:

a. The alteration or addition to a permitted facility may meet one of the criteria for determining whether a facility is a new source in 40 CFR Part 122.29(b) [48 FR 14153, April 1, 1983, as amended at 49 FR 38046, September 26, 1984]; or

b. The alteration or addition could significantly change the nature or increase the quantity of pollutants discharged. This notification applies to pollutants which are subject neither to effluent limitations in the permit, nor to notification requirements under 40 CFR Part 122.42(a)(1) [48 FR 14153, April 1,1983, as amended at 49 FR 38046, September 26, 1984].

2. Anticipated Noncompliance

The permittee shall give advance notice to the Director of any planned changes in the permitted facility or activity which may result in noncompliance with permit requirements.

3. Transfers

This permit is not transferable to any person except after notice to the Director. The Director may require modification or revocation and reissuance of the permit to change the name of the permittee and incorporate such other requirements as may be necessary under the Clean Water Act.

4. Monitoring Reports

Monitoring results shall be reported at the intervals and in the form specified in Section C, paragraph 5 (Monitoring).

5. Compliance Schedules

Reports of compliance or noncompliance with, or any progress reports on, interim and final requirements contained in any compliance schedule of this permit shall be submitted no later than 14 days following each schedule date. Any reports of noncompliance shall include the cause of noncompliance, any remedial actions taken, and the probability of meeting the next scheduled requirement.

6. Twenty Four Hour Reporting

The permittee shall report any noncompliance which may endanger health or the environment. Any information shall be provided orally within 24 hours from the time the permittee becomes aware of the circumstances. A written submission shall also be provided within 5 days of the time the permittee becomes aware of the circumstances. The written submission shall contain a description of the noncompliance and its cause; the period of noncompliance, including exact dates and times, and if the noncompliance has not been corrected, the anticipated time it is expected to continue; and steps taken or planned to reduce, eliminate, and prevent reoccurrence of the noncompliance. The Director may waive the written report on a case-by-case basis if the oral report has been received within 24 hours.

The following shall be included as information which must be reported within 24 hours:

a. Any unanticipated bypass which exceeds any effluent limitation in the permit.

b. Any upset which exceeds any effluent limitation in the permit.

c. Violation of a maximum daily discharge limitation for any of the pollutants listed by the Director in Part III of the permit to be reported within 24 hours.

7. Other Noncompliance

The permittee shall report all instances of noncompliance not reported under Section D, paragraphs 4, 5, and 6, at the time monitoring reports are submitted. The reports shall contain the information listed in Section D, paragraph 6.

8. Changes in Discharges of Toxic Substances

The permittee shall notify the Director as soon as it knows or has reason to believe:

a. That any activity has occured or will occur which would result in the discharge, in a routine or frequent basis, of any toxic pollutant which is not limited in the permit, if that discharge will exceed the highest of the "notification levels" described in 40 CFR Part 122.42(a)(1) [48 FR 14153, April 1, 1983, as amended at 49 FR 38046, September 26, 1984].

b. That any activity has occured or will occur which would result in any discharge, on a non-routine or infrequent basis, of a toxic pollutant which is not limited in the permit, if that discharge will exceed the highest of the "notification levels" described in 40 CFR Part 122.42(a)(2) [48 FR 14153, April 1,1983, as amended at 49 FR 38046, September 26, 1984).

9. Duty to Provide Information

The permittee shall furnish to the Director, within a reasonable time, any information which the Director may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this permit, or to determine compliance with this permit. The permittee shall also furnish to the Director, upon request, copies of records required to be kept by this permit.

10. Duty to Reapply

If the permittee wishes to continue an activity regulated by this permit after the expiration date of this permit, the permittee must apply for and obtain a new permit. The application shall be submitted at least 180 days before the expiration date of this permit. The Director may grant permission to submit an application less than 180 days in advance but no later than the permit expiration date.

11. Signatory Requirements

All applications, reports, or information submitted to the Director shall be signed and certified.

a. All permit applications shall be signed as follows:

(1) For a corporation: by a responsible corporate officer. For the purpose of this section, a responsible corporate officer means:

(i) A president, secretary, treasurer, or vice-president of the corporation in charge of a principal business function, or any other person who performs similar policy or decision making functions for the corporation, or

(ii) the manager of one or more manufacturing, production, or operating facilities employing more than 250 persons or having gross annual sales or expenditures exceeding $25 million (in second-quarter 1980 dollars), if authority to sign documents has been assigned or delegated to the manager in accordance with corporate procedures.

(2) For a partnership or sole proprietorship: by a general partner or the proprietor, respectively.

(3) For a municipality, State, Federal, or other public agency: by either a principal executive officer or ranking elected official. For purposes of this section, a principal executive officer of a Federal agency includes:

(i) The chief executive officer of the agency, or

(ii) a senior executive officer having responsibility for the overall operations of a principal geographic unit of the agency.

b. All reports required by the permit and other information requested by the Director shall be signed by a person described above or by a duly authorized representative of that person. A person is a duly authorized representative only if:

(1) The authorization is made in writing by a person described above.

(2) The authorization specifies either an individual or a position having responsibility for the overall operation of the regulated facility or activity, such as the position of plant manager, operator of a well or a well field, superintendent, or position of equivalent responsibility, or an individual or position having overall responsibility for environmental matters for the company. A duly authorized representative may thus be either a named individual or any individual occupying a named position; and

(3) The written authorization is submitted to the Director.

c. Certification. Any person signing a document under this section shall make the following certification:

"I certify under penalty of law that this document and all attachments were prepared under the direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

12. Availability of Reports

Except for data determined to be confidential under 40 CFR Part 2, all reports prepared in accordance with the terms of this permit shall be available for public inspection at the office of the Director. As required by the Clean Water Act, the name and address of any permit applicant or permittee, permit applications, permits, and effluent data shall not be considered confidential.

13. Penalties for Falsification of Reports

The Clean Water Act provides that any person who knowingly makes any false statement, representation, or certification in any record or other document submitted or required to be maintained under this permit, including monitoring reports or reports of compliance or noncompliance shall, upon conviction, be punished by a fine of not more than $10,000 per violation, or by imprisonment for not more than 6 months per violation, or by both.

PART III
OTHER CONDITIONS

A. There shall be no discharge of polychlorinated biphenyl transformer fluid.

B. The "daily average" concentration means the arithmetic average (weighted by flow value) of all the daily determinations of concentration made during the calendar month. Daily determinations of concentration made using a composite sample shall be the concentration of the composite sample. When grab samples are used, the daily determination of concentration shall be the arithmetic average (weighted by flow value) of all the samples collected during that calendar day.

The "daily maximum" concentration means the daily determination of concentration for any calendar day.

C. Daily average temperature is defined as the flow weighted average temperature (FWAT) and shall be computed and recorded on a daily basis. FWAT shall be computed at equal time intervals not greater than two hours. The method of calculating FWAT is as follows:

$$\text{FWAT} = \frac{\text{SUMMATION (INSTANTANEOUS FLOW X INSTANTANEOUS TEMPERATURE)}}{\text{SUMMATION (INSTANTANEOUS FLOW)}}$$

D. The term "low-volume wastesources" means, taken collectively as if from one source, wastewater from all sources except those for which specific limitations are otherwise established. Low volume waste sources include, but are not limited to: wastewater from wet scrubber air pollution control systems, ion exchange water treatment systems, water treatment evaporator blowdown, laboratory and sampling streams, boiler blowdown, floor drains, cooling tower basin cleaning wastes, and recirculating house service water systems. Sanitary and air conditioning wastes are not included.

E. The applicant's makeup water intake structure, located on the Colorado River, meets the requirements of Section 316 (b) of the Clean Water Act and is hereby approved.

F. The term "total residual chlorine" (or total residual oxidants for intake water with bromides) means the value obtained using the amperometric method for total residual chlorine described in 40 CFR Part 136.

Total residual chlorine may not be discharged from any single generating unit for more than two hours per day unless the discharger demonstrates to the permitting authority that discharge for more than two hours is required for macroinvertabrate control.

Simultaneous multi-unit chlorination is permitted.

CITY HALL
BURTON POLICE DEPT
KNITTE
BSB
BSB

City Hall and Police Station - Burton

APPENDIX B

SOCIOECONOMICS

Texas Assessment Modeling System (TAMS)

TAMS is a comprehensive computerized technique for projecting the economic, demographic, public service, and fiscal impacts of lignite development in Texas. Projections supplied by the model cover the areas of business activity, personal income, employment, population, school enrollment housing, law enforcement, medical services, and local government revenues, expenditures, and net fiscal balances.

The TAMS was designed for a 53 county area in Texas including Fayette, Lee, and Washington counties. Projections for Colorado County, which is not in the model area but is in the study area, were derived using manual methods.

The model is based on certain assumptions which are the basis for projections about future impacts. The accuracy of the model is totally dependant upon the validity of these assumptions and the accuracy of the data used in making them. The major general assumption underlying this model is that historical relationships and trends in these relationship will persist throughout the projection period. Critical assumptions in the TAMS include patterns of settlement based on city populations derived from ratios of city to regional population, and past mortality trends assumed to continue while fertility rates were set at various predetermined levels. One very critical assumption is that rates of migration are expected to continue to reflect employment opportunities in the predicted manner. Changes in any of the factors upon which these assumptions are based will affect the quality of the projection. This is evidenced by a recent decline in oil and gas activity in the project area which is not taken into account by the model.

The TAMS model was designed to be versatile and flexible, however, the model does have limitations. The use and interpretation of any projections must take into account these limitations, and the assumptions upon which the model is based (Texas A&M, 1982).

SOCIOECONOMIC IMPACT PROJECTIONS*

COUNTIES: / PARAMETERS:	TOTAL PROJECT IN MIGRATION	NUMBER OF CONSTRUCTION WORKERS RESIDING IN COUNTY	OPERATION EMPLOYMENT RESIDENCE	INDIRECT LABOR RESIDENCE	NET FISCAL IMPACT	MEDICAL SERVICE NEEDS	TOTAL CRIMINAL OFFENSES	POLICE ENFORCEMENT NEEDS
COLORADO	26 (peak)	3-9	3-9	5-10	+$0-$2K**	<1 Add. Hosp. Bed <1 Add. Doctor	.84	<1 Add. Officer <1 Add. Vehicle
FAYETTE	411 (peak)	31-124	7-116	45-131	+$0-$46K	1-2 Add. Hosp. Bed <1 Add. Doctor	12.55	<1 Add. Officer <1 Add. Vehicle
LEE	140 (peak)	1-28	3-36	8-20	+$1K-$17K	<1 Add. Hosp. Bed <1 Add. Doctor	4.69	<1 Add. Officer <1 Add. Vehicle
WASHINGTON	251 (peak)	1-48	6-67	16-34	+$3K-$30K	<1 Add. Hosp. Bed <1 Add. Doctor	7.51	<1 Add. Officer <1 Add. Vehicle

< = Less than.

** = in thousands

* = "Socioeconomic Update Cummins Creek Mine and Fayette Power Project Units 3 & 4." LCRA. July 1984.

Add = Additional

SOCIOECONOMIC IMPACT PROJECTIONS

CITIES: / PARAMETERS:	TOTAL PROJECT IN-MIGRATION	NUMBER OF CONSTRUCTION WORKERS RESIDING IN CITY	OPERATION EMPLOYMENT RESIDENCE	INDIRECT LABOR RESIDENCE	NET FISCAL IMPACT	SCHOOL FISCAL IMPACTS	SCHOOL ENROLLMENT	HOUSING NEEDS *
COLUMBUS	26 (peak)	3-9	3-9	5-10	$0 -($7K)#	+$ 3K -($10K)	+1-4 primary +1-4 secondary	7 s.f. 2 apts. 2 m.h. 0 a.h.
CARMINE **	88 (peak)	2-6	3-26	0 or 1	+$1K -($22K)	+$ 5K -($39K)	+1-17 primary +1-16 secondary	17 s.f. 4 apts. 3 m.h. 1 a.h.
FAYETTEVILLE	33 (peak)	3-11	2-9	4-12	($1K)-($12K)	+$ 2K -($12K)	+1-6 primary +1-5 secondary	6 s.f. 2 apts. 1 m.h. 0 a.h.
FLATONIA	3	1-2	1	1-2	$0 -($1K)	$ 0 -($ 3K)	+1 primary +1 secondary	1 s.f. 0 apt. 0 m.h. 0 a.h.
LA GRANGE	271 (peak)	26-102	4-75	37-109	($6K)-($84K)	+$ 4K -($105K)	+2-48 primary +2-45 secondary	55 s.f. 16 apts. 11 m.h. 3 a.h.
ROUND TOP ***	0-3	0-1	0-1	0	$0 -($1K)	+$ 5K -($39K)	+1-17 primary +1-6 secondary	1 s.f. 0 apts. 0 m.h. 0 a.h.
SCHULENBERG	15 (peak)	2-7	2-4	3-8	$0 -($5K)	+$ 2K -($ 5K)	+1-2 primary +1-2 secondary	3 s.f. 1 apt. 1 m.h. 0 a.h.
GIDDINGS	137 (peak)	1-26	3-35	8-19	+$1K -($43K)	+$ 7K -($62K)	+2-28 primary +2-28 secondary	22 s,f. 7 apts. 5 m.h. 2 a.h.

SOCIOECONOMIC IMPACT PROJECTIONS (Con't)

CITIES: / PARAMETERS:	TOTAL PROJECT IN MIGRATION	NUMBER OF CONSTRUCTION WORKERS RESIDING IN CITY	OPERATION EMPLOYMENT RESIDENCE	INDIRECT LABOR RESIDENCE	NET FISCAL IMPACT	SCHOOL FISCAL IMPACTS	SCHOOL ENROLLMENT	HOUSING NEEDS*
LEXINGTON	3	1-2	1	0 or 1	$0 -($1K)	$ 0 -($3K)	+1 primary +1 secondary	1 s.f. 0 apt. 0 m.h. 0 a.h.
BRENHAM ****	201 (peak)	1-43	4-54	16-33	+$5K -($67K)	+$10K -($87K)	+12-40 primary +14-36 secondary	31 s.f. 10 apt. 8 m.h. 3 a.h.
BURTON	53 (peak)	2-5	2-14	0 or 1	+$1K -($18K)	+$3K -($22K)	+1-10 primary +1-9 secondary	9 s.f. 3 apts. 2 m.h. 1 a.h.

- Number in ( ) denotes negative or minus.

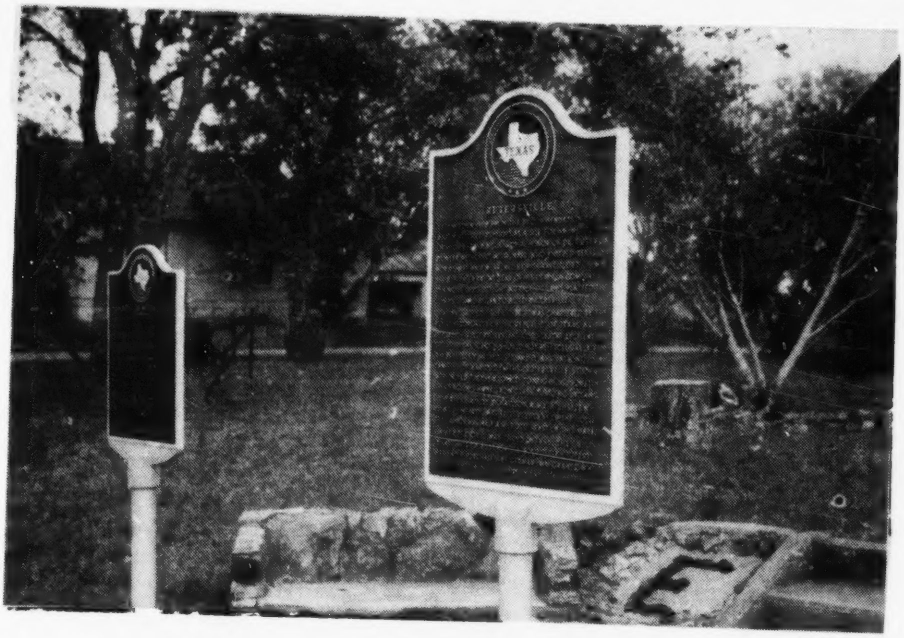
* - s.f. = single family units
apt. = apartments
m.h. = mobile homes
a.h. = ad hoc units

** - Carmine and Round Top have a joint school district.

*** - No "project" or in-migration population is expected to locate in Round Top, therefore, no socio-economic impacts are anticipated except in 1984.

**** - Brenham school facilities are "overcrowded".

SOURCE: "Socioeconomic Update Cummins Creek Mine and Fayette Power Plant Units 3 & 4." LCRA. July 1984.



Historical Markers - Rutersville

APPENDIX C

SOUND QUALITY

NOISE MODELING

The computer model used to predict noise levels is an environmental noise model developed by Morrison-Knudsen for Sound Attenuation from Multiple Point Sources of Noise (SAMPSON). An environmental noise model is designed to compute noise levels at considerable distances from a multiple set of noise sources incorporating the basic physics of sound propagation and attenuation as affected by atmospheric characteristics.

The SAMPSON model is able to incorporate noise properties including multiple sources, geometrical spreading, molecular absorption, excess attenuation from ground interference, temperature gradient, and wind gradients. Up to 20 point sources of noise and 50 noise receptor positions (up to 3.8 miles from the point source) were used in each run of the model to predict noise levels.

The 50 receptor positions were spread throughout the mining area to define the noise pattern. Receptors were also placed in a local church, cemetary and town. Two sets of noise sources were used in two runs of the model, the results of which can be overlapped as needed.

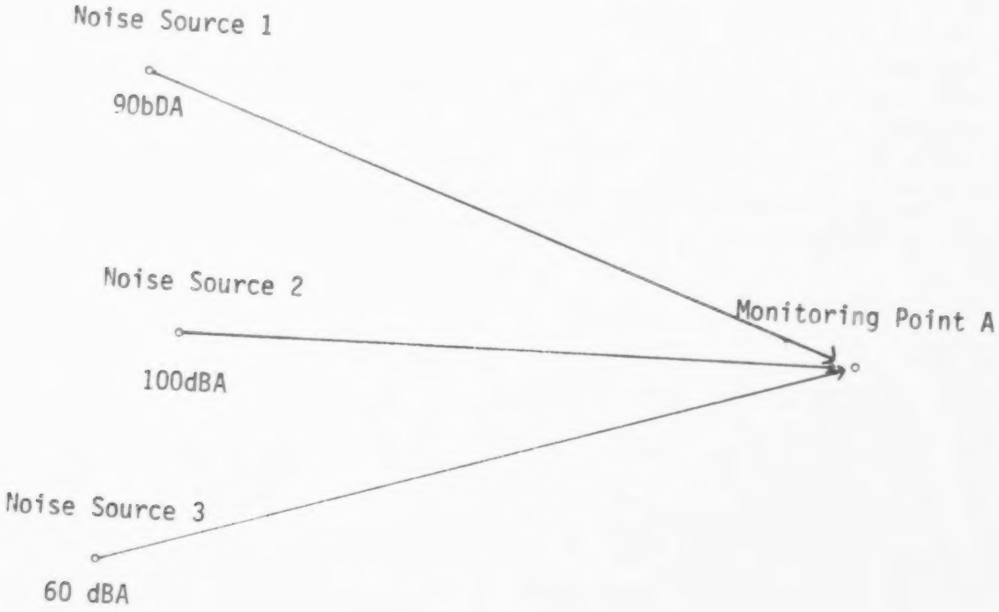
As with any model, several assumptions are necessary in order to make predictions. Some assumptions made in the SAMPSON model include neglecting small noise sources since these impacts should be obscured by larger noise sources, and consideration of diesel equipment as one point source. Construction noise sources were not modeled because of their short duration and the fact that they will generally be lower than operation noise levels. Configuration of point source locations was designed to represent average equipment positions allowing model results to be interpreted as predicted average noise levels.

NOISE MODELING

SAMPSON (Sound Attenuation from Multiple Point Sources of Noise)

- Calculates Noise Levels at discrete receptor points (up to 50) at distances of up to 20,000 feet (3.8 miles) from any source.
- Incorporates noise attenuation effects due to geometrical spreading, molecular absorption, ground interference, temperature gradients and upwind and downwind gradient effects.
- Does not include other attenuation due to vegetation, barriers, buildings or such meteorological phenomena as rain or fog.

Noise level at Point A is the logarithmic sum of all noise sources impinging on that point


Noise Source 1
90bDA
Noise Source 2
100dBA
Monitoring Point A
Noise Source 3
60 dBA

Resultant Noise = log sum of the three source noises minus attenuation effects.

NOISE MODELING

ADDING TWO NUMBERS LOGARITHMICALLY

Example 1:

Two Noise Sources - 63dBA and 68 dBA

Step 1 - Divide both numbers by 10 = 6.3 and 6.8
Step 2 - Raise 10 to the powers shown

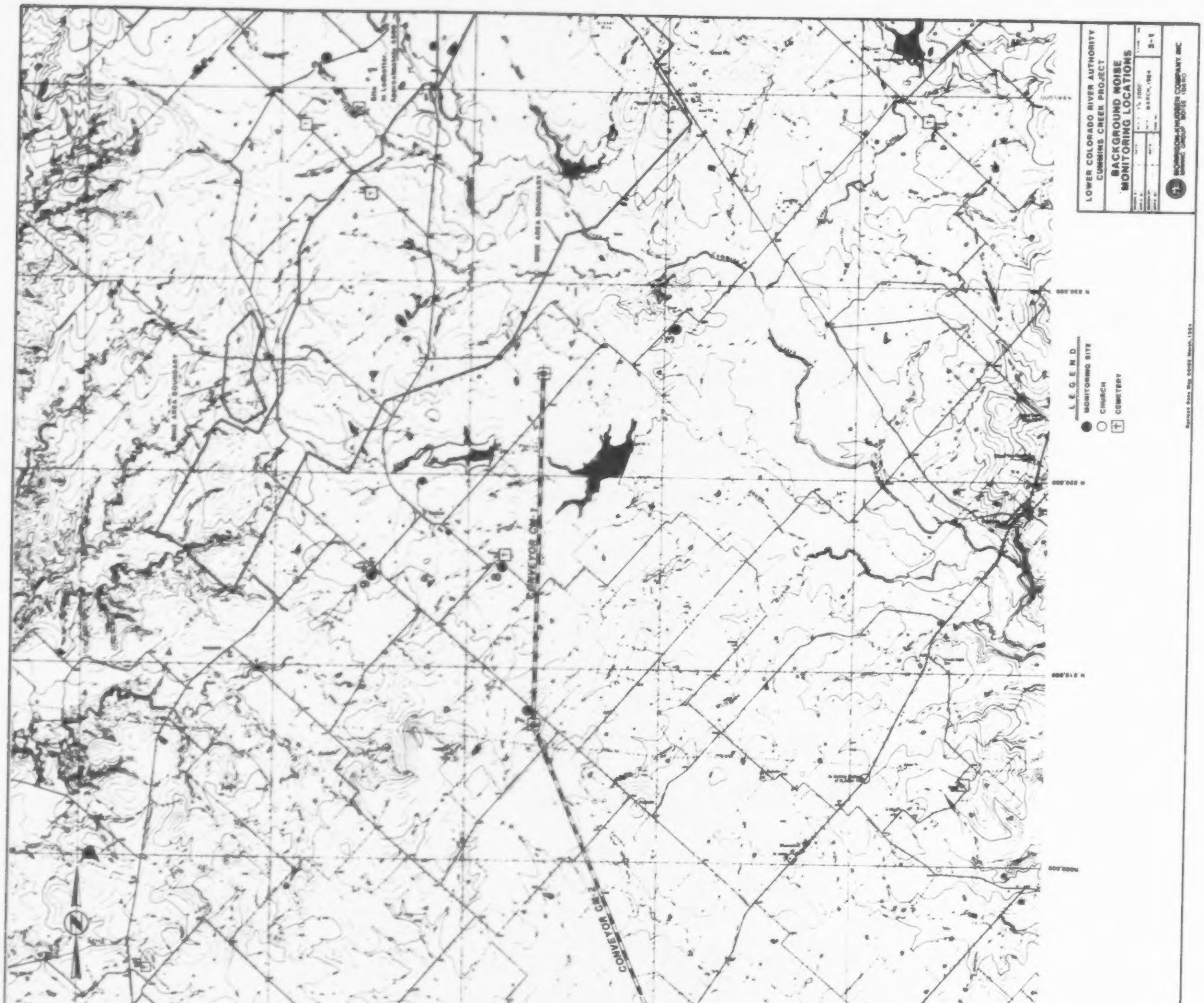
$$\begin{aligned} 10^{6.3} &= 1,995,262 \\ 10^{6.8} &= \underline{6,309,573} \end{aligned}$$

Step 3 - Add 8,304,845
Step 4 - Take $\log_{10}$ = 8,304,845 = 6.919
Step 5 - Multiply by 10 = 69.19 = resulting noise level

Example 2:

Two Noise Sources - 46 dBA and 20 dBA

Step 1 - 46 ÷ 10 = 4.6   20 ÷ 10 = 2
Step 2 - $10^{4.6} = 39810.7$
$10^{2.0} = \underline{100.0}$
Step 3 - 39910.7
Step 4 - $\log_{10} 39910.7 = 4.601$
Step 5 - 4.601 x 10 = 46.01


LOWER COLORADO RIVER AUTHORITY
CUMMINS CREEK PROJECT
BACKGROUND NOISE MONITORING LOCATIONS
1" = 2000'
MARCH, 1984
3-1
MORRISON-KNUDSEN COMPANY INC
MINING GROUP BOISE IDAHO
LEGEND
● MONITORING SITE
○ CHURCH
CEMETERY
CONVEYOR CN-1
CONVEYOR CN-2
CONVEYOR CN-3
MINE AREA BOUNDARY
N

Reproduced from best available copy.

EXISTING NOISE LEVELS

CUMMINS CREEK PROJECT
NOISE MONITORING PROGRAM SOUND LEVELS (dBA)

Site	L_{eq}	L_{dn}	L_{max}	L_{10}	L_{50}	L_{90}	L_{min}
1	65	--	a	69	62	58	47
2	43	50	b	45	40	34	b
3	49	50	b	51	40	33	b
4[c]	69	69[d]	95	71	53	45	38
5	69	69[d]	95	71	53	45	38
6	46	50[d]	81	48	42	34	26
7[c]	64	68[d]	99	62	52	47	40
8	47	50[d]	84	47	38	31	28
9[c]	65	65[d]	93	65	52	46	39

a. Recorder span set at 30-80 dBA. Maximum value is well above 80 dBA.

b. Recorder span set at 30-80 dBA. Maximum value may be slightly above 80 dBA. Minimum value may be slightly below 30 dBA.

c. All values are adjusted to correct from a flat response to A-weighted response based on data from Site 5.

d. Estimated based on data from Sites 2 and 3.

CUMMINS CREEK PROJECT
AVERAGE NOISE LEVELS BY CATEGORY (dBA)

Category 1:	Average highway noise levels, along FM 1291 and Highway 159 (Sites 4, 5, 7, and 9).
Category 2:	Average noise levels at background Sites, located in relatively quiet areas (Sites 2, 3, 6, and 8).

Category	L_{eq}	L_{dn}	L_{max}	L_{10}	L_{50}	L_{90}	L_{min}
1	67	68	96	67	53	46	39
2	46	50	83	48	40	33	27

L_{eq} = equivalent noise level
L_{dn} = L_{eq} with 10 dBA added to night level
L_{max} = highest instantaneous sound level
L_{min} = lowest instantaneous sound level
L_{10} = dBA level exceeded 10 percent of a 24 hour period
L_{50} = dBA level exceeded 50 percent of a 24 hour period
L_{90} = dBA level exceeded 90 percent of a 24 hour period

NOISE INVENTORY

SOURCE SOUND LEVELS (dBA) AT 50 FEET

Equipment	Sound Level
Haul Trucks (multiple)	101
Grader	90
Water Truck	90
Fuel Truck	90
Continuous Surface Miner	89
Scraper	89
Front-end Loader	84
Bucket Wheel Excavator	83
Dragline	83
Dozer	83
Trucks Unloading	78
Feeder-Breaker	76
Conveyor Transfer (Sheetwork Only)	82
Conveyor Transfer (Sound Insulation)	63
Conveyor	63

NOISE MODELING RESULTS

The model results for calm and wind conditions are reproduced as Tables One and Two. Table One provides the calculated noise levels expected at each receptor from all sources as a function of stability category and as a sum weighted by stability percentages. These values are decibels on the A-weighted scale due only to mine noise sources. Background noise level has not been included. Table Two provides similar results under moving air conditions, for each of 16 wind directions. These results can only be examined one direction at a time. That is, when the wind blows consistently from some specified direction, this table gives the expected impacts at all receptors.

In both tables, the receptor with the highest noise level is Receptor 16, with a calm wind noise level of 74.45 dBA. This receptor is at the center of the mine very close to several significant noise sources. Under windy conditions, the noise level at this receptor varies between 68 dBA (wind from SW) and 75 dBA (wind from E). This variance is a function of the receptor's position in relation to nearby noise sources. Since receptor 16 is in the middle of several noise sources, its variance with direction is not large.

Other more isolated receptors, Receptor 49 for example, show greater variation of noise level with wind direction. Receptor 49 ranges from approximately 15 dBA (wind from ESE through SSW) to 37 dBA (wind from NNW). The range is wide since Receptor 49 is more removed from the mine area and all of the noise sources are generally to the north and northwest.

Table One

CUMMINS CREEK PROJECT
MINE NOISE LEVELS -- YEAR 8
CALM WINDS

Noise Impacts (dBA) to Receptors From All
Sources Combined -- Calm Winds

- -- By Stability Class
- -- By Weighted Sum of Stabilities

Receptor	STABILITY CLASS A	B	C	D	E	F	G	Weighted Sum
1	37.95	37.85	37.85	46.46	51.28	52.52	55.98	47.14
2	42.83	42.83	42.83	51.82	56.80	57.08	60.13	52.20
3	44.91	44.91	44.91	53.95	59.01	59.22	62.51	54.36
4	44.19	44.19	44.19	52.79	58.63	60.32	63.88	53.95
5	42.79	42.79	42.79	51.75	56.67	57.12	60.95	52.25
6	43.00	43.00	43.00	51.90	55.19	55.74	58.81	51.79
7	38.48	38.48	38.48	47.66	52.33	52.91	56.51	48.04
8	53.12	53.12	53.12	62.14	64.34	64.40	66.60	61.41
9	59.48	59.48	59.48	68.48	70.70	70.71	72.95	67.75
10	57.77	57.77	57.77	66.76	69.25	69.27	71.72	66.16
11	52.46	52.46	52.46	61.44	65.75	65.79	68.81	61.53
12	47.15	47.15	47.15	56.16	60.63	60.74	64.07	56.36
13	36.94	36.94	36.94	46.10	50.09	51.95	55.36	46.54
14	44.64	44.64	44.64	53.87	58.93	59.11	62.57	54.26
15	53.17	53.17	53.17	52.21	67.06	67.06	70.20	62.48
16	66.24	66.24	66.24	75.24	77.32	77.32	79.39	74.45
17	61.03	61.03	61.03	70.03	72.58	72.58	74.91	69.42
18	50.61	50.61	50.61	65.15	72.79	74.67	74.95	65.42
19	41.21	41.21	41.21	50.59	55.30	56.19	60.17	51.06
20	50.56	50.56	50.56	59.60	64.57	64.62	67.97	59.95
21	62.15	62.15	62.15	71.15	73.26	73.26	75.36	70.37
22	60.79	60.79	60.79	69.79	72.06	72.06	74.31	69.08
23	46.82	46.82	46.82	55.73	60.84	61.00	64.78	56.23
24	46.09	46.09	46.09	55.24	60.22	60.36	64.08	55.64
25	53.21	53.21	53.21	64.01	70.74	72.96	73.80	64.84
26	55.21	55.21	55.21	64.22	67.88	67.91	70.64	64.05
27	45.03	45.03	45.03	54.04	59.00	59.21	62.88	54.47
28	44.83	44.83	44.83	53.80	57.65	58.11	61.50	53.88
29	49.61	49.61	49.61	58.72	62.03	62.15	65.36	58.49
30	49.79	49.79	49.79	58.90	61.29	61.76	64.53	58.39
31	41.30	41.30	41.30	49.99	54.55	55.83	59.26	50.57
32	37.13	37.13	37.13	46.76	50.01	52.12	55.95	46.96
33	47.64	47.64	47.64	56.62	61.58	61.69	64.71	56.95
34	57.46	57.46	57.46	66.45	68.68	68.71	70.84	65.72
35	42.61	42.61	42.61	51.45	56.35	56.80	60.64	51.97
36	36.18	36.18	36.18	44.74	48.34	51.19	54.80	45.42
37	38.14	38.14	38.14	47.36	52.27	52.49	56.75	47.80
38	52.78	52.78	52.78	61.78	64.20	64.22	66.44	61.12
39	60.29	60.29.	60.29	69.29	71.29	71.29	73.30	68.46
40	42.05	42.05	42.05	50.99	55.93	56.13	60.09	51.46
41	33.91	33.91	33.91	41.85	45.82	48.89	52.76	42.86
42	29.42	29.42	29.42	35.46	40.46	44.37	47.61	37.32
43	40.78	40.78	40.78	49.90	54.62	54.97	58.95	50.29
44	43.33	43.33	43.33	52.31	57.30	57.37	60.54	52.66
45	37.48	37.48	37.48	46.59	51.78	51.78	55.75	47.00
46	31.10	31.10	31.10	38.40	42.79	46.20	49.84	39.74
47	24.62	24.62	24.62	34.45	36.97	40.27	43.67	34.60
48	29.45	29.45	29.45	38.92	41.82	44.66	47.59	39.10
49	21.65	21.65	21.65	30.03	34.74	38.08	41.30	31.20
50	22.92	22.92	22.92	31.55	35.39	39.51	42.21	32.50

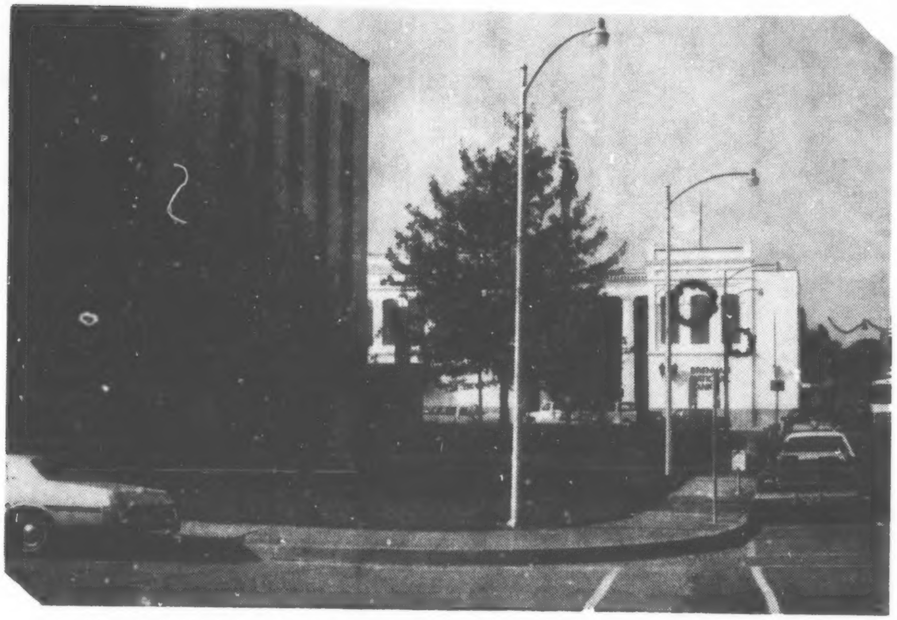
Table Two

CUMMINS CREEK PROJECT
NOISE LEVELS -- YEAR 8
WINDY CONDITIONS

Noise Impacts (dBA) to Receptors From All Sources Combined -- Wind Conditions

- -- By Wind Direction
- -- Using a Weighted Sum of Stabilities
- -- Source Impacts to a Receptor for a Given Wind Direction Depend on Downwind, Crosswind, and Upwind Sectors

	WIND DIRECTION															
Receptor	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
1	42.46	46.55	47.31	49.30	49.31	49.55	47.69	47.50	45.44	39.04	32.48	32.48	32.48	32.48	33.03	35.74
2	52.22	52.70	54.83	54.82	54.52	52.17	51.89	37.28	37.25	37.25	37.25	37.25	37.72	37.73	42.08	52.20
3	50.23	54.96	55.33	55.44	56.64	56.36	56.22	53.78	53.18	45.31	45.31	45.31	46.23	46.24	47.32	48.72
4	54.54	55.02	55.25	57.01	56.99	57.19	55.91	55.69	52.20	51.50	51.33	51.61	51.61	51.62	50.03	50.62
5	48.36	49.61	52.14	53.01	54.68	54.74	54.18	52.17	51.86	50.95	47.50	46.41	46.41	45.62	46.30	46.64
6	39.94	50.22	51.12	52.30	52.77	53.38	52.85	52.43	51.68	47.04	44.05	40.54	40.19	39.94	39.94	39.94
7	50.40	50.40	48.40	48.05	48.04	42.08	32.78	32.66	32.66	32.66	32.66	32.78	32.78	46.90	48.02	50.19
8	62.31	62.43	61.62	61.53	61.38	48.73	44.90	44.76	44.75	44.75	44.75	44.79	44.79	61.23	61.37	62.23
9	63.63	63.63	64.26	64.00	64.00	67.76	67.76	68.13	68.13	68.13	68.13	67.30	67.30	61.87	61.88	63.32
10	65.79	66.24	67.03	67.27	67.20	66.43	66.02	57.98	57.75	63.76	52.28	52.39	52.40	52.71	54.65	65.72
11	55.97	58.97	60.50	62.18	62.43	63.41	63.28	63.07	60.77	59.12	58.28	52.74	52.66	52.48	53.04	53.00
12	52.67	53.81	54.52	56.35	56.91	57.83	57.95	57.82	56.93	55.35	54.76	54.00	53.22	53.17	52.67	52.67
13	48.94	47.56	46.85	44.36	43.21	34.11	32.32	31.95	31.95	31.95	31.95	47.79	44.04	46.36	48.15	48.73
14	55.90	55.66	51.74	51.24	50.58	48.89	47.71	47.70	47.69	47.59	52.72	52.88	55.16	55.62	56.09	55.80
15	64.55	64.30	64.28	61.98	61.78	61.74	61.53	61.52	62.02	62.27	62.66	62.66	62.70	62.33	62.84	62.85
16	68.22	68.10	73.88	73.88	74.73	74.69	74.68	73.79	73.75	73.75	73.76	67.79	68.44	68.46	68.57	68.06
17	67.62	68.37	68.45	68.45	68.43	68.43	68.99	69.66	69.90	69.74	69.66	69.41	68.95	69.20	68.93	67.95
18	64.71	64.06	64.06	64.18	64.46	64.66	64.84	64.91	65.14	65.51	65.45	62.57	62.14	62.00	64.71	64.71
19	53.84	51.65	50.81	50.19	47.60	44.74	44.69	44.52	44.52	46.16	46.30	47.18	50.55	51.51	53.53	53.75
20	60.71	60.82	59.98	62.00	61.88	61.26	61.27	61.27	61.31	61.32	61.37	59.04	59.06	62.16	62.11	62.61
21	69.87	69.83	69.81	69.09	69.09	69.09	67.80	67.80	69.36	69.41	69.82	69.88	69.88	69.51	70.31	70.30
22	56.03	53.72	53.48	68.78	68.78	68.81	69.79	69.82	69.92	69.17	69.22	59.07	59.86	59.58	58.15	56.27
23	48.10	44.23	45.98	46.62	54.20	54.68	55.74	57.69	57.94	58.65	57.37	57.32	54.07	53.00	49.55	48.10
24	57.73	56.59	55.17	52.49	53.43	53.04	53.04	52.91	52.80	52.81	53.95	56.05	56.38	56.45	57.76	57.72
25	64.40	64.40	62.21	62.13	62.17	62.05	62.02	61.99	62.31	62.31	63.36	63.68	67.68	68.37	68.28	65.80
26	61.42	61.38	62.17	62.18	62.20	61.22	61.23	63.93	61.70	61.90	63.06	63.90	63.80	61.63	61.59	54.58
27	40.75	39.36	40.16	49.20	49.22	49.71	55.15	55.45	56.97	56.51	56.53	53.70	53.44	53.02	44.64	41.79
28	54.36	53.84	53.87	53.68	53.61	50.81	50.38	48.23	47.18	48.44	50.61	50.62	51.08	53.68	54.11	54.82
29	57.52	56.76	47.21	57.54	57.67	57.74	57.12	57.39	57.52	58.09	57.33	58.16	58.58	58.53	58.27	57.65
30	57.24	43.97	46.90	46.90	47.15	49.28	49.43	50.79	52.55	58.49	58.94	59.55	59.42	58.84	58.10	57.89
31	36.15	35.63	35.63	39.78	39.90	41.15	48.95	50.71	52.41	53.13	53.14	51.59	50.34	50.28	46.58	38.29
32	49.69	49.59	47.84	45.87	45.77	42.89	32.05	32.05	32.05	32.34	40.18	40.88	41.00	45.59	47.46	48.90
33	58.85	59.51	59.43	57.72	56.61	51.93	51.93	40.58	40.62	42.57	45.36	46.77	48.16	55.80	55.79	57.04
34	55.84	57.73	65.57	65.57	65.81	66.62	66.62	66.49	65.67	65.42	56.91	57.09	57.10	56.93	56.74	56.06
35	43.17	37.13	37.13	46.85	50.61	52.04	53.56	53.63	53.19	52.07	52.15	51.67	58.92	48.59	46.21	45.77
36	30.37	29.96	29.96	29.96	41.05	41.14	42.99	46.63	46.86	46.39	47.32	47.26	46.03	43.44	43.35	34.49
37	50.51	49.75	47.47	47.44	32.04	32.04	32.04	32.04	32.04	35.26	37.27	37.93	48.04	48.10	49.05	50.54
38	61.88	61.87	61.06	60.49	41.20	41.20	41.20	41.20	41.21	42.79	43.22	52.54	61.10	61.56	61.56	62.27
39	61.08	61.07	61.06	61.06	61.06	68.00	68.00	68.00	69.28	69.28	69.36	68.56	68.56	62.97	62.96	62.96
40	38.02	36.62	36.62	36.62	36.62	49.16	51.16	53.18	54.16	54.20	52.75	51.66	51.63	48.21	41.13	40.76
41	27.82	27.64	27.64	27.64	27.64	41.20	41.31	43.79	45.28	45.32	44.84	43.91	43.86	38.30	37.74	36.05
42	21.58	21.58	21.58	21.58	21.58	33.23	33.40	37.81	38.67	39.64	40.24	39.78	38.84	34.67	34.38	24.72
43	50.27	50.19	35.66	35.66	35.66	35.66	35.66	35.66	35.67	37.55	50.27	50.38	53.29	53.29	53.23	50.27
44	38.32	47.32	37.32	37.32	37.32	37.32	37.32	37.32	52.61	52.65	55.06	55.46	55.46	53.33	52.66	52.65
45	32.14	31.30	31.30	31.30	31.30	31.30	45.71	46.76	46.93	49.83	49.93	50.09	47.45	47.26	41.35	35.36
46	24.48	24.37	24.37	24.37	24.37	24.37	38.70	38.92	41.77	42.52	43.42	42.21	41.40	39.88	32.90	31.95
47	38.28	38.21	35.22	34.82	28.26	19.60	17.35	17.35	17.35	17.35	17.35	17.48	32.94	34.06	34.97	38.09
48	39.27	39.48	39.04	35.06	27.01	25.92	22.24	22.24	22.24	22.24	26.82	36.90	38.63	38.93	39.00	39.29
49	35.27	32.29	31.48	24.04	21.36	15.13	15.13	15.13	15.13	15.13	16.84	29.51	30.04	34.72	36.67	36.91
50	15.97	15.97	15.97	23.45	31.76	32.27	37.43	38.02	37.90	33.66	31.81	31.25	17.39	15.97	15.97	15.97



Washington County Courthouse - Brenham

APPENDIX D

SOILS

Lower Colorado River Authority
Post Office Box 220 Austin, Texas 78767 AC 512 473-3200
DON L. SPRAGGINS, Director of Environmental Resources • 473-3213

October 31, 1984

Mr. Ron Reeves, Hearings Examiner
Surface Mining and Reclamation Division
Railroad Commission of Texas
P.O. Drawer 12967 - Capitol Station
Austin, Texas 78711

Re: Cummins Creek Support Facility Permit Application, Docket No. 20, Exhibit 2, Provision No. 10

Dear Mr. Reeves:

The chemical characteristics of soils representative of the Support Facility Permit Area are shown in Table 3.9-2 on page 3.9-11 of the Cummins Creek Support Facility Permit Application, Docket No. 20. The Falba and Tremona soils, listed in Table 3.9-2, exhibited above average exchangeable sodium values. These values were obtained in 1981 from Core Laboratories, Inc. in Corpus Christi, Texas. The analytical method used for determining exchangeable Na and cation exchange capacity (CEC) was "Methods of Soil Analysis" (Black, 1965).

In October of 1983, the Falba soil was sampled on the Toennis property, within the Support Facility Permit Area. The samples were also analyzed by Core Laboratories in Corpus Christi and the results indicated no excessive exchangeable sodium values (Table 1).

In addition, on October 25, 1984, topsoil and subsoil samples were obtained for the Falba and Tremona soils within the Support Facility Permit Area. The samples were sent to Deuel and Zahray Laboratories in College Station, Texas. The extraction solutions used for determining exchangeable Na and CEC were ammonium acetate buffered at pH 7 and sodium acetate buffered at pH 8, respectively.

The results of the 1984 analysis indicated that the Falba and Tremona soils on the Support Facility Site exhibited exchangeable sodium values well within the normal range. This data is shown in the Table 2.

In comparing the 1983 and 1984 analyses to that of 1981, it is probable that discrepancies between the sample data are results of either analytical error, differences in laboratory methodology, on-site contamination of soils by petroleum exploration activities and/or inherent site differences. In any event, the results obtained in 1983 and 1984 prove that exchangeable sodium is not problematic for any soil within the Cummins Creek Support Facility Permit Area.

This information is offered as a late-filed exhibit and we ask that it be received into evidence in this proceeding. Mr. Ken Launius, Mining /Reclamation Supervisor with LCRA will be available for cross-examination concerning these matters, if requested by the parties.

In summation we request the Railroad Commission of Texas delete the proposed provision No. 10 for the Cummins Creek Support Facility Permit Application, Docket No. 20 in support of the data presented herein.

If you have any questions, please contact Ken Launius at 473-3567.

Sincerely,

Don L. Spraggins
Director of
Environmental Resources

DLS/KWL/pw
Enclosures
cc: James Blackburn
John Soule
Ken W. Launius

TABLE 1

Cummins Creek Support Facility Permit Application, Docket 20

Results Obtained from 1983 Soils Sampling

Map Unit Symbol	Depth (in)	pH	Conductivity (umhos/cm @ 25° C)	Cation Exchange Capacity (MEQ/100G)	Major Exchangeable Bases (MEQ/100G) Na	Ca	Mg	K
36B	0 - 6	5.50	97	5.90	0.03	2.56	0.68	0.08
36B	6 - 12	5.80	46	2.40	0.18	1.38	0.30	0.04
36B	12 -18	5.14	93	29.10	0.98	11.12	4.39	0.23

TABLE 2

Cummins Creek Support Facility Permit Application, Docket 20

Results Obtained from 1984 Soils Sampling

Sample No.	Soil	Location*	Depth (in.)	CEC (meq/100g)	Exchangeable Na (meq/100g)	SAR	ESP (%)	pH	EC (mmhos/cm)
36B	Falba	1A	0 - 10	8.3	0.3	4.4	3.5	6.5	0.23
36B	Falba	1B	10 - 16	26.8	2.10	14.2	7.8	4.8	0.42
77B	Tremona	1A	0 - 8	14.3	0.4	7.0	2.7	5.8	0.44
77B	Tremona	1B	8 - 14	24.4	0.7	7.6	3.0	5.0	0.36

*1 - Support Facility Permit Area
A - Topsoil
B - Subsoil

Field Sample Descriptions

From March 8 to March 11, 1982, field samples -- for chemical and physical analyses -- were collected from open pits within the Cummins Creek Mine Area. Additional field samples, also for chemical and physical analyses, were collected from within the Cummins Creek Mine Area from October 5 to October 7, 1982, and in September of 1983. Descriptions of the soils taken from the sample pits were prepared by an SCS Soil Scientist. A majority of the soils pits, which were sampled and described by the SCS, are outside the permit area. However, field verifications of soils within the permit area were made by soil scientists and are comparable with those previously described by the SCS.

This section of the report contains the following information for each soil: soil series, soil mapping unit, site number, location, cover, topography and a detailed profile description of each soil. Site numbers for each soil correspond to the soil sample site numbers shown on Exhibit 3.9-1. For example, in Site Number 118A-4, 118A is the soil mapping unit and 4 is the soil sample site number.

Arol Series

118A -- Arol fine sandy loam, 0 to 2 percent slopes

Site No.: 118A-4.
Cover: Closely grazed Coastal bermudagrass pasture with scattered post oak.
Topography: Gently sloping upland; 1 percent slope; southerly aspect.

A 0 to 9 inches

Gray (10YR 6/1) fine sandy loam, very dark grayish brown (10YR 3/2) moist; single grained structure; slightly hard, friable; common fine roots; mildly alkaline; abrupt smooth boundary.

Bt1 9 to 24 inches

Very dark gray (10YR 3/1) gravelly sandy clay, black (10YR 2/1) moist; moderate medium subangular blocky structure; slightly hard, friable; common fine roots; gravels (< 5mm) occupy approximately 5 percent of the volume; moderately alkaline; gradual wavy boundary.

Bt2 24 to 42 inches

Dark gray (10YR 4/1) gravelly clay, very dark gray (10YR 3/1) moist; moderate medium angular blocky structure; slightly hard, friable; gravels (5mm) occupy less than 5 percent of the volume; moderately alkaline; gradual wavy boundary.

Bt3 42 to 65 inches

Dark gray (10YR 4/1) sandy clay, very dark gray (10YR 3/1) moist; moderate medium angular blocky structure; slightly hard, friable; moderately alkaline; gradual wavy boundary.

BC 65 to 80 inches

Gray (10YR 5/1) and very pale brown (10YR 7/3) tuffaceous sand, dark gray (10YR 4/1) and pale brown (10YR 6/3) moist; few fine faint yellowish brown (10YR 5/6) mottles; moderate coarse angular blocky structure; very hard, very firm; neutral.

118B -- Arol fine sandy loam, 1 to 5 percent slope, eroded

Site No. 118B-14
Cover: Overgrazed pasture - dominated by broomweed.
Topography: Gently sloping upland, 1 percent slope.

A 0 to 4 inches

Dark gray (10YR 2/1) sandy clay loam, moist; single grained structure; friable; common fine roots; neutral; abrupt smooth boundary.

Bt1 4 to 16 inches

Very dark gray (10YR 3/1) sandy clay; moist; medium angular blocky structure; slightly hard, friable; few fine roots; gravels (<5mm) comprise less than 5 percent of volume; slightly acid; abrupt smooth boundary.

Bleiblerville Series

8B -- Bleiblerville clay, 1 to 3 percent slopes

Site No.: 8B-12.
Cover: Broomweed; occasional cedar trees; various grasses.
Topography: Gently sloping upland; 2½ percent slope.

A1 0 to 10 inches

Very dark gray (10YR 3/1) clay, black (10YR 2/1) moist; moderate medium angular blocky structure; very hard, very firm; many medium and fine roots; few small concretions and few fine threads of calcium carbonate; few fine gravels (up to 7 cm diameter); moderately alkaline; clear smooth boundary.

A2 10 to 36 inches

Black (10YR 2/1) clay, black (10YR 4/1) moist; strong medium angular blocky structure; extremely hard, very firm; few fine and medium roots; many large intersecting slickensides tilted 30 to 60 degrees from horizontal; many large pressure faces; few small concretions and few fine threads of calcium carbonate; moderately alkaline; clear smooth boundary.

A3 36 to 50 inches

Dark gray (10YR 4/1) clay, dark gray (10YR 4/1) moist; strong medium angular blocky structure; slickensides tilted 30 to 60 degrees from horizontal; many large pressure faces; few small concretions and few fine threads of calcium carbonate; moderately alkaline; clear smooth boundary.

Cr 50 to 72 inches

White (10YR 8/1) tuffaceous material, white (10YR 8/2) moist; massive; few fine distinct strong brown (7.5YR 4/6) stains on ped faces; extremely hard, very firm; few fine calcium carbonate concretions; moderately alkaline.

Bunyan Series

149 -- Bunyan soils, frequently flooded

In this part of Fayette County, these soils are slightly more sandy and more acid than is typical for the series.

Site No.: 149-11
Cover: Grasses; post oak; live oak.
Topography: Nearly level bottomland; 0 to 1 percent slope.

A1 0 to 5 inches

Pale brown (10YR 6/3) loamy fine sand, brown (10YR 5/3) moist; weak medium subangular blocky structure; loose, very friable; many fine, common medium and few coarse roots; very strongly acid; clear smooth boundary.

A2 5 to 10 inches

Pale brown (10YR 6/3) fine sandy loam, dark brown (10YR 4/3) moist; weak fine subangular blocky structure; soft, very friable; many fine, common medium and few coarse roots; strongly acid; clear smooth boundary.

A3 10 to 15 inches

Light brownish gray (10YR 6/2) fine sandy loam, grayish brown (10YR 5/2) moist; weak medium subangular blocky structure; slightly hard, friable; many fine, common medium and few coarse roots; strongly acid; gradual wavy boundary.

C1 15 to 21 inches

Dark gray (10YR 4/1) sandy clay loam, very dark gray (10YR 3/1) moist; moderate fine and medium subangular blocky structure; hard, firm; many fine, common medium and few coarse roots; strongly acid; gradual wavy boundary.

C2 21 to 30 inches

Pale brown (10YR 6/3) fine sandy loam, brown (10YR 5/3) moist; weak fine subangular blocky structure; slightly hard, friable; slightly acid; gradual wavy boundary.

C3 30 to 39 inches

Very pale brown (10YR 7/3) fine sandy loam, brown (10YR 5/3) moist; weak medium subangular blocky structure; soft, very friable; slightly acid; clear smooth boundary.

C4 39 to 74 inches

Very pale brown (10YR 8/3) loamy fine sand, very pale brown (10YR 7/4) moist; single grained; loose, very friable; slightly acid; gradual smooth boundary.

C5 74 to 80 inches

Very pale brown (10YR 8/4) gravelly fine sand, very pale brown (10YR 7/4) moist; single grained; loose; gravels (up to 76 mm diameter) constitute approximately 50 percent by volume; slightly acid.

Burlewash Series

35B -- Burlewash fine sandy loam, 1 to 5 percent slopes

In Fayette County, these soils are often more alkaline than is typical for the series. Also, sola thickness is slightly more than is typical for the series.

Site No.: 35B-10
Cover: Bermuda pasture with few live oak trees.
Topography: Very gently sloping upland; 1 percent slope.

A 0 to 6 inches

Light brownish gray (10YR 6/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; moderate medium subangular blocky structure; loose, very friable; common fine and medium roots; few siliceous rounded pebbles (1 - 2 cm diameter); strongly acid; abrupt smooth boundary.

Bt1 6 to 16 inches

Yellowish red (5YR 5/8) clay, yellowish red (5YR 4/8) moist; few medium faint grayish brown (10YR 5/2) mottles; strong coarse angular blocky structure; extremely hard, very firm; common fine and medium roots; dark clay films on ped faces; few very coarse sand grains; strongly acid; gradual wavy boundary.

Bt2 16 to 25 inches

Brown (10YR 5/3) sandy clay, dark brown (10YR 4/3) moist; moderate medium angular blocky structure; very hard, very firm; few fine roots; few clay films on ped faces; few small calcium carbonate concretions; moderately alkaline; gradual wavy boundary.

BC 25 to 45 inches

White (10YR 8/2) sandy clay loam, light brownish gray (10YR 6/2) moist; few medium faint strong brown (7.5YR 5/8) mottles; moderate medium angular blocky structure; hard, firm; few fine calcium carbonate concretions; moderately alkaline; gradual wavy boundary.

CR 45 to 60 inches

White (10YR 8/1) clayey tuff, white (10YR 8/1) moist; few fine faint strong brown (7.5YR 5/6) mottles; massive; hard, friable; moderately alkaline.

Falba Series

36B -- Falba fine sandy loam, 0 to 2 percent slopes

Site No.: 36B-2
Cover: Post oak; yaupon; little bluestem.
Topography: Gently undulating upland; 1 percent slope.

A 0 to 4 inches

Light gray (10YR 7/1) fine sandy loam, dark yellowish brown (10YR 3/4) moist; weak fine granular structure; loose, very friable; common fine roots; slightly acid; abrupt smooth boundary.

E 4 to 10 inches

Light gray (10YR 7/2) fine sandy loam, dark yellowish brown (10YR 4/4) moist; weak fine granular structure; loose, very friable; common fine roots;

slightly acid; abrupt wavy boundary. E is defined as a mineral horizon in which the main feature is loss of silicate clay, iron, aluminum or some combination of these, leaving a concentration of sand and silt particles of quartz or other resistant minerals. An E horizon is usually, but not necessarily, lighter in color than an underlying B horizon.

Bt1 10 to 26 inches

Brown (10YR 5/3) sandy clay, dark brown (7.5YR 4/4) moist; common fine faint strong brown (7.5YR 4/6) mottles; moderate medium angular blocky structure; slightly hard, friable; many fine roots; neutral; gradual wavy boundary.

Bt2 26 to 39 inches

Grayish brown (10YR 5/2) sandy clay, dark gray (10YR 4/1) moist; moderate medium angular blocky structure; slightly hard, friable; few small stones (10 mm); few sand pockets; many fine roots; moderately alkaline; clear wavy boundary.

BC 39 to 47 inches

Very pale brown (10YR 7/3) and grayish brown (10YR 5/2) sandy clay loam, gray (10YR 5/1) and light gray (10YR 7/2) moist; few dark yellowish brown (10YR 4/6) mottles; weak medium angular blocky structure; soft, very friable; few fine roots; moderately alkaline; gradual wavy boundary.

C 47 to 60 inches

Light gray (2.5YR 7/2) weakly cemented sand; moderate coarse angular blocky structure; mildly alkaline.

36B - Falba fine sandy loam, 0 to 2 percent slopes

Site No.: 36B-15
Cover: Improved Coastal bermudagrass pasture.
Topography: Nearly level upland; 1 percent slope.

A 0 to 6 inches

Pale brown (10YR 5/4) very fine sandy loam, moist; weak fine granular structure; friable; common fine roots; strongly acid; smooth abrupt boundary.

E 6 to 12 inches

Brownish gray, gray (10YR 7/2) loamy fine sand, moist; single-grained structure; loose; common fine roots; medium acid; smooth abrupt boundary.

Bt1 12 to 18 inches

Brown (10YR 5/3) sandy clay, moist; angular blocky structure; slightly hard, firm; strongly acid; smooth abrupt boundary.

Bt2 18 to 24 inches

Grayish brown (10YR 5/2) sandy clay, moist; angular blocky structure; hard, firm gravels (<5mm) comprise less than 5 percent of volume; strongly acid; smooth abrupt boundary.

36B -- Falba fine sandy loam, 0 to 2 percent slopes

Site No.: 36B-3
Cover: Closely grazed Coastal bermudagrass pasture with scattered post oaks.
Topography: Nearly level upland; 1 percent slope; slightly concave.

A 0 to 7 inches

Pinkish gray (7.5YR 6/2) fine sandy loam, grayish brown (10YR 5/2) moist; weak fine granular structure; soft, very friable; common fine roots; slightly acid; abrupt smooth boundary.

E 7 to 14 inches

Very pale brown (10YR 7/3) fine sandy loam, light yellowish brown (10YR 6/4) moist; weak fine granular structure; soft, very friable; common fine roots; slightly acid; abrupt wavy boundary.

Bt1 14 to 23 inches

Brown (10YR 5/3) sandy clay, dark grayish brown (10YR 4/2) moist; common fine distinct brownish yellow (10YR 6/8) mottles; moderate medium angular blocky structure; hard, firm; many fine roots; gravels (<5mm) occupy approximately 5 percent by volume; very strongly acid; gradual wavy boundary.

Bt2 23 to 36 inches

Grayish brown (10YR 5/2) sandy clay, dark gray (10YR 4/1) moist; moderate medium angular blocky structure; hard, firm; many fine roots; gravels (<5mm) occupy approximately 5 percent by volume; moderately alkaline; clear wavy boundary.

BC 36 to 60 inches

Very pale brown (10YR 7/3) sandy clay loam, pale brown (10YR 6/3) moist; moderate coarse angular blocky structure; hard, firm; gravels (<5mm) occupy approximately 10 percent by volume; moderately alkaline.

34C -- Falba Variant loamy fine sand, 1 to 5 percent slopes

Site No.: 34C-7
Cover: Closely grazed Coastal bermudagrass pasture with scattered post oak.
Topography: Gently rolling upland; about 1 percent slope; westerly aspect.

A 0 to 7 inches

Pale brown (10YR 6/3) fine sandy loam, dark brown (10YR 4/3) moist; single-grained structure; loose; common fine roots; slightly acid; abrupt smooth boundary.

E 7 to 14 inches

White (10YR 8/2) fine sandy loam, light yellowish brown (10YR 6/4) moist; single-grained structure; loose; many fine roots; neutral; abrupt wavy boundary.

Bt1 14 to 22 inches

Yellowish brown (10YR 5/4) sandy clay, light yellowish brown (10YR 6/4) moist; many medium distinct dark red (2.5YR 3/6) mottles; moderate medium angular blocky structure; hard, friable; few fine roots; extremely acid; gradual wavy boundary.

Bt2 22 to 35 inches

Yellowish brown (10YR 5/4) sandy clay, dark brown (10YR 4/3) moist; common medium distinct dark red (2.5YR 3/6) mottles; moderate medium angular blocky structure; very hard, very firm; extremely acid; clear wavy boundary.

Bt3 35 to 48 inches

Grayish brown (10YR 5/2) and very pale brown (10YR 7/4) sandy clay, dark grayish brown (10YR 4/2) and pale brown (10YR 6/3) moist; moderate medium angular blocky structure; very hard, very firm; mildly alkaline; gradual wavy boundary.

BC 48 to 72 inches

Very pale brown (10YR 7/3) sand; few medium distinct (2.5YR 3/6) mottles; moderate medium subangular blocky structure; hard; moderately alkaline.

34C -- Falba Variant loamy fine sand, 1 to 5 percent slopes

Site No.: 34C-9
Cover: Forested rangeland with post oak, blackjack oak and yaupon.
Topography: Nearly level upland; 1 percent slopes.

A 0 to 5 inches

Light brownish gray (10YR 6/2) loamy fine sand, dark yellowish brown (10YR 4/4) moist; weak fine granular structure; soft, very friable; very strongly acid; abrupt smooth boundary.

E 5 to 14 inches

White (10YR 8/2) loamy fine sand, pale brown (10YR 6/3) moist; single grained structure; soft, very friable; neutral; abrupt wavy boundary.

Bt1 14 to 23 inches

Dark grayish brown (10YR 4/2) sandy clay, brown (10YR 5/3) moist; common medium distinct strong brown (7.5YR 5/6) mottles; moderate medium angular blocky structure; extremely hard, extremely firm; few small pebbles present; neutral; gradual wavy boundary.

Bt2 23 to 31 inches

Gray (10YR 5/1) and light gray (10YR 7/2) sandy clay, light brownish gray (10YR 6/2) moist; common medium distinct yellowish red (5YR 5/8) mottles; weak coarse angular blocky structure; extremely hard, extremely firm; few small pebbles present; mildly alkaline; clear wavy boundary.

Bt3 31 to 69 inches

Light brownish gray (10YR 6/2) sandy clay loam, gray (10YR 5/1) moist; common medium distinct reddish yellow (7.5YR 6/8) and gray (7.5YR 6/0) mottles; weak coarse angular blocky structure; extremely hard, extremely firm; moderately alkaline; abrupt wavy boundary.

Cr 69 to 84 inches

Brown (7.5YR 5/2) very gravelly sandy loam, pinkish gray (7.5YR 6/2) moist; weak fine subangular blocky structure; gravels (up to 102 to 127 mm diameter) occupy approximately 70 percent of the volume.

34C -- Falba Variant loamy fine sand, 1 to 5 percent slopes

Site No.: 34C-16
Cover: Well-managed hay meadow.
Topography: Gently rolling, upland; 2 to 5 percent slopes.

A 0 to 9 inches

Light brown (10YR 5/2) very fine sandy loam, moist; weak fine granular structure; very friable; strongly acid; abrupt smooth boundary.

E 9 to 14 inches

Light gray (10YR 7/2) loamy fine sand, moist; single grained structure; very friable; medium acid; abrupt wavy boundary.

Bt1 14 to 18 inches

Gray brown (10YR 3/1) sandy clay, moist; weak angular blocky structure; slightly hard, firm; medium acid; abrupt smooth boundary.

Tremona Series

33B -- Tremona loamy fine sand, 0 to 5 percent slopes

Site No.: 33B-17
Cover: Overgrazed Coastal bermudagrass pasture.
Topography: Upland, 1 percent slopes.

A 0 to 3 inches

Brown (10YR 5/2) very fine sandy loam, moist; friable, common fine roots; gravels (<5mm) make up less than 5 percent of volume; strongly acid; abrupt wavy boundary.

E 3 to 6 inches

Pale brown (10YR 7/3) loamy fine sand, moist; soft, friable; gravels (<5mm) make up less than 5 percent of volume; strongly acid; abrupt smooth boundary.

Bt1 6 to 12 inches

Yellowish brown (10YR 6/4) sandy clay, moist; firm, hard; gravels common with some up to 2 inches in diameter; medium acid; abrupt wavy boundary.

77B -- Tremona very gravelly loamy fine sand, 0 to 5 percent slopes

Site No.: 77B-5
Cover: Little bluestem, post oak, yaupon.
Topography: Nearly level upland; 1 percent slopes.

A 0 to 5 inches

Grayish brown (10YR 5/2) loamy fine sand, dark brown (10YR 3/3) moist; single-grained structure; loose; common fine roots; medium acid; clear smooth boundary.

E 5 to 24 inches

Very pale brown (10YR 7/3) loamy fine sand, yellowish brown (10YR 5/4) moist; single-grained structure; loose; common fine roots; strongly acid; abrupt wavy boundary.

Bt1 24 to 32 inches

Light brownish gray (10YR 6/2) very gravelly sandy clay, grayish brown (10YR 5/2) moist; many medium distinct dark red (10YR 3/6) and strong brown (7.5YR 5/8) mottles; moderate medium angular blocky structure; very hard, very firm; few fine roots; extremely acid; gradual wavy boundary.

Bt2 32 to 42 inches

Brown (10YR 5/3) gravelly sandy clay, light yellowish brown (10YR 6/4) moist; many medium distinct yellowish red (5YR 5/8) and dark reddish brown (2.5YR 3/4) mottles; moderate medium angular blocky structure; very hard, very firm; extremely acid; gradual wavy boundary.

BC 42 to 52 inches

Pale brown (10YR 6/3) sand, brown (10YR 5/3) moist; few medium distinct dark red (10YR 3/6) and strong brown (7.5YR 5/8) mottles; weak medium angular blocky structure; slightly hard, friable; extremely acid; diffuse wavy boundary.

C 52 to 80 inches

Very pale brown (10YR 7/3) tuffaceous material; slightly hard; very strongly acid.

77B -- Tremona very gravelly loamy fine sand, 0 to 5 percent slopes

Site No.: 77B-8
Cover: Post oak rangeland; some little bluestem.
Topography: Gently rolling upland; 2 to 3 percent slopes; southwesterly aspect.

A11 0 to 8 inches

Very pale brown (10YR 7/3) loamy fine sand, brown (10YR 5/3) moist; single-grained structure; soft, very friable; common small roots; strongly acid; clear smooth boundary.

A12 8 to 15 inches

Very pale brown (10YR 7/3) loamy fine sand, light yellowish brown (10YR 7/3) loamy fine sand, light yellowish brown (10YR 6/4) moist; single-grained structure; soft, very friable; gravels (up to 51 mm diameter) occupy approximately 5 percent of the volume; common small roots; slightly acid; gradual wavy boundary.

E 15 to 25 inches

White (10YR 8/1) very gravelly loamy fine sand, pale brown (10YR 6/3) moist; weak fine subangular blocky structure; soft, very friable; gravels (up to 51 mm diameter) occupy approximately 50 percent of the volume; common small roots; slightly acid; abrupt wavy boundary.

Bt1 25 to 39 inches

Grayish brown (10YR 5/2) very gravelly sandy clay, pale brown (10YR 6/3) moist; few medium prominent dark red (10YR 3/6) mottles; moderate medium angular blocky structure; very hard, very firm; gravels (up to 25 mm diameter) occupy approximately 40 percent of the volume; few fine roots; extremely acid; gradual wavy boundary.

Bt2 39 to 52 inches

Dark grayish brown (10YR 4/2) gravelly sandy clay, light yellowish gray (10YR 6/2) moist; strong coarse angular blocky structure; very hard, very firm; gravels (up to 13 mm diameter) occupy approximately 20 percent of the volume; extremely acid; gradual wavy boundary.

C1 52 to 69 inches

White (10YR 8/2), pale brown (10YR 6/3) and brown (10YR 5/3) tuffaceous sand; moderate coarse angular blocky structure; hard, firm; extremely acid; diffuse wavy boundary.

C2 69 to 80 inches

White (10YR 8/2) volcanic tuff; moderate medium subangular blocky structure; extremely acid.

77B -- Tremona very gravelly loamy fine sand, 0 to 5 percent slopes

Site No.: 77B-18
Cover: Well-managed Coastal bermudagrass pasture.
Topography: Gently rolling uplands; 2 to 5 percent slopes.

A 0 to 8 inches

Brown (10YR 5/3) gravelly loamy fine sand; single-grained structure; soft, friable; common small roots; gravels comprise up to 50 percent of volume; medium acid, abrupt smooth boundary.

E 8 to 10 inches

Light brown (10YR 7/3) loamy fine sand; single-grained structure; soft, friable; few small roots; gravels comprise up to 50 percent of volume; strongly acid; abrupt smooth boundary.

Bt1 10 to 18 inches

Brown (10YR 5/3) sandy clay, reddish brown (7.5YR 3/8) moist; moderate angular blocky structure; hard, firm; gravels comprise up to 50 percent of volume; medium acid; abrupt smooth boundary.

150B -- Tremona soils, graded, 0 to 5 percent slopes

Site No: 150B-1
Cover: None (Site located in gravel pit).
Topography: Gently rolling upland; 3 percent slopes; slightly convex.

A 0 to 8 inches

This site was located in gravel pit. Thickness of A horizon applies to landscape since approximately 3 feet of gravelly overburden had been removed. Light gray (10YR 7/1) very gravelly loamy sand, yellowish brown (10YR 5/4) moist; weak fine granular structure; loose, very friable; gravels (up to 76 mm diameter) occupy approximately 60 percent of the volume; very strongly acid; clear smooth boundary.

Bt1 8 to 24 inches

Light yellowish brown (10YR 6/4) gravelly sandy clay, brown (10YR 5/3) moist; few medium faint yellowish red (10YR 4/6) mottles; moderate very coarse subangular blocky structure; slightly hard, friable; gravels (< 5mm) occupy approximately 5 percent of the volume; extremely acid; gradual wavy boundary.

Bt2 24 to 44 inches

Brown (10YR 5/3) sandy clay, dark brown (10YR 4/3) moist; few medium faint yellowish red (10YR 4/6) mottles; strong coarse subangular blocky structure; hard, very friable; several pockets of translocated sand; extremely acid; gradual wavy boundary.

C 44 to 60 inches

White (10YR 8/1) weakly cemented fine sand; brownish yellow (10YR 6/8) stains on peds; strong medium angular blocky structure; very hard; extremely acid.

150B -- Tremona soils, graded, 0 to 5 percent slopes

Site No.: 150B-6.
Cover: None (Site located in gravel pit).
Topography: Gently rolling upland; 2 percent slopes.

A 0 to 5 inches

This site was located in gravel pit. Thickness of A horizon applies to existing landscape since approximately 3 feet of gravelly overburden had been removed. Yellowish brown (10YR 5/4) very gravelly loamy sand, dark yellowish brown (10YR 4/4) moist; single-grained structure; loose; very strongly acid; clear smooth boundary.

E 5 to 24 inches

Yellowish brown (10YR 5/6) very gravelly loamy sand, dark yellowish brown (10YR 4/6) moist; single-grained structure; loose; very strongly acid; abrupt wavy boundary.

Bt1 24 to 32 inches

White (10YR 8/2) gravelly sandy clay, light gray (10YR 7/2) moist; many distinct medium/coarse red (2.5YR 5/8, 10YR 5/8) and dusky red (10YR 3/4) mottles; weak fine subangular blocky structure; soft, very friable; gravels occupy approximately 60 percent of the volume; extremely acid; gradual wavy boundary.

Bt2 32 to 42 inches

White (2.5YR 8/2) gravelly sandy clay, light gray (2.5YR 7/2) moist; common distinct medium/coarse yellowish red (5YR 5/8) and red (2.5YR 5/8) mottles; weak fine subangular blocky structure; soft, very friable; gravels occupy 65 to 70 percent of the volume; extremely acid; gradual wavy boundary.

BC 42 to 52 inches

White (10YR 8/2) fine sandy loam, light gray (10YR 7/1) moist; weak medium subangular blocky structure; slightly hard, friable; extremely acid; diffuse wavy boundary.

C 52 to 80 inches

Light gray (10YR 7/1) fine sandy loam, gray (10YR 6/1) moist; weak medium subangular blocky structure; slightly hard, friable; few/common fine white concretions; extremely acid.

Established Series
Rev. WRM:LCD
3/81

AROL SERIES

The Arol series consists of moderately deep, somewhat poorly drained, very slowly permeable soils that formed from moderately consolidated clayey tuff. These soils are on plane or slightly concave uplands. They are saturated in winter and early spring. Slopes range from 0 to 5 percent.

Taxonomic Class: Fine, montmorillonitic, thermic Typic Albaqualfs.

Typical Pedon: Arol fine sandy loam--pasture.
(Colors are for moist soil unless otherwise stated.)

Ap--0 to 6 inches; dark grayish brown (10YR 4/2) fine sandy loam, grayish brown (10YR 5/2) dry; massive; hard, friable; many fine roots; medium acid; abrupt smooth boundary. (3 to 12 inches thick)

B21tg--6 to 18 inches; black (10YR 2/1) clay, very dark gray (10YR 3/1) dry; moderate medium blocky structure; very hard, very firm, sticky and plastic; common fine roots; thin patchy clay films on faces of peds; few shiny pressure faces; medium acid; gradual wavy boundary. (8 to 15 inches thick)

B22tg--18 to 30 inches; very dark gray (10YR 3/1) clay, dark gray (10YR 4/1) dry; moderate coarse blocky structure; very hard, very firm, sticky and plastic; common fine roots; thin patchy clay films on faces of peds; few shiny pressure faces; slightly acid; abrupt smooth boundary. (7 to 14 inches thick)

Cr--30 to 45 inches; pale olive (5Y 6/3) clayey tuff; massive and weakly bedded; extremely hard, extremely firm; can be cut with a spade; gray stains between cleavage planes; neutral.

Type Location: Walker County, Texas; from the intersection of Interstate 45 and Texas Highway 30 in Huntsville, Texas; 4.6 miles north along west access road of I-45 and northwest on U.S. Highway 75 to the intersection on Wire Road; then 2.7 miles west on Wire Road and 320 feet south in pasture.

Range in Characteristics: Solum thickness ranges from 20 to 40 inches. The COLE may exceed 0.09 in the B2tg horizons of some pedons, but the potential linear extensibility of the soil is less than 6 cm.

The A horizon is dark grayish brown (10YR 4/2; 2.5Y 4/2), grayish brown (10YR 5/2; 2.5Y 5/2), light brownish gray (10YR 6/2; 2.5Y 6/2), or dark gray (10YR 4/1, 5/1, 6/1). The A2g horizon, where present, has values that are one or two units higher than the A1 horizon. Texture is loam or fine sandy loam. Reaction of the A horizon is medium or strongly acid.

The B21tg horizon is black (10YR 2/1; N 2/0), very dark gray (10YR 3/1, N 3/0), very dark grayish brown (10YR 3/2), or dark brown (7.5YR 3/2). Reaction ranges from neutral to strongly acid. The B22tg horizon is black (10YR 2/1, N 2/0),very dark gray (10YR 3/1, N 3/0), dark gray (10YR 4/1), gray (10YR 5/1, 6/1), dark grayish brown (10YR 4/2; 2.5Y 4/2), grayish brown (10YR 5/2; 2.5Y 5/2), or dark brown (7.5YR 3/2). The B2tg horizons are clay to clay loam, with the clay content ranging from 35 to 50 percent. Reaction ranges from medium acid to mildly alkaline.

A B3 horizon, where present, ranges from slightly acid to moderately alkaline.

The Cr horizon is pale olive (5Y 6/3), light olive gray (5Y 6/2), olive (5Y 5/3), light gray (5Y 7/2; 2.5Y 7/2; 10YR 7/1, 7/2), light brownish gray (2.5Y 6/2; 10YR 6/2), or brown (10YR 5/3). The Cr layer ranges from clayey tuff to clay or tuffaceous friable sand, containing small amounts of volcanic materials, to very fine grained weakly consolidated sandstone. Reaction of the Cr horizon is medium acid to moderately alkaline. Some pedons are calcareous. Roots seldom enter the Cr horizon, but are along cleavage planes in a few places.

Competing Series: These are the Alusa, Corrigan, Crowley, Falba, and Meikle series in the same family and the Burlewash, Cherokee, Edna, Lufkin, and Shalba series in similar families. Alusa, Cherokee, Crowley, Edna, Meikle, and Lufkin soils have sola thicker than 40 inches. Corrigan soils occur in areas of higher rainfall with an average summer soil moisture deficit of less than 4 inches. Falba soils have color values of 3.5 or greater in the B21tg horizon are very strongly acid to strongly acid in the Btg horizon. Burlewash soils are well drained and have higher chroma colors in the Bt horizons. Shalba soils have sola less than 20 inches thick.

Geographic Setting: Arol soils are on uplands. Slopes range from 0 to 5 percent and are plane to weakly concave. The soils formed in interbedded tuffaceous clays, ash beds, sandstones, and pyroclastics as typified by the Catahoula and associated formations. The average annual precipitation ranges from 35 to 45 inches and the average annual temperature ranges from 67° to 70° F. Thornthwaite annual P-E indices range from 55 to 72. The soils occur in areas with a summer moisture deficit of 6 to 9 inches on the average.

Geographically Associated Soils: These are the competing Burlewash, Falba, Lufkin, and Shalba series and the Elmina, Leson, Mabank, and Redco series. Burlewash soils are on nearby sloping areas. Falba, Lufkin, and Shalba soils are on similar landscape positions. Elmina soils have sandy surface layers 20 to 40 inches thick. Leson and Redco soils have intersecting slickensides and are clayey throughout. Mabank soils have sola thicker than 40 inches and have vertic properties.

Drainage and Permeability: Somewhat poorly drained. Slow runoff. Slow internal drainage. Very slow permeability. Soil is saturated during the winter and spring months of most years.

Use and Vegetation: Used mainly as pastureland. Large acreages were once planted to cotton and corn, but are now idle or in low quality pastures of threeawn grasses and annuals. Improved pastures are mainly coastal bermudagrass. Native grasses are little bluestem, indiangrass, switchgrass, big bluestem, and sideoats grama with a thin overstory of post oak trees.

Distribution and Extent: Southeastern and south-central Texas. The series is of moderate extent, about 100,000 acres.

Series Established: Walker County, Texas; 1975.

Remarks: Arol soils were formerly classified in the Planosol great soil group. They were formerly mapped in the Wilson series.

Additional Data: National Soil Survey Laboratory - S70TX-236-4.

TX0309

SOIL INTERPRETATIONS RECORD

MLRA(S): 87
WRH.LCB. 11-78
TYPIC ALBAQUALFS, FINE, MONTMORILLONITIC, THERMIC

AROL SERIES

THE AROL SERIES CONSISTS OF MODERATELY DEEP, SOMEWHAT POORLY DRAINED NEARLY LEVEL TO GENTLY SLOPING SOILS OF UPLANDS. THE SOIL FORMED IN CLAYEY DEPOSITS. IN A REPRESENTATIVE PROFILE, THE SURFACE LAYER IS DARK GRAYISH BROWN FINE SANDY LOAM ABOUT 6 INCHES THICK. THE SUBSOIL IS VERY FIRM CLAY 24 INCHES THICK AND IS BLACK IN THE UPPER PART AND VERY DARK GRAY IN THE LOWER PART. THE SUBSTRATUM BELOW 30 INCHES IS PALE OLIVE CLAYEY TUFF. SLOPES RANGE FROM 0 TO 5 PERCENT.

ESTIMATED SOIL PROPERTIES (A)

DEPTH (IN.)	USDA TEXTURE	UNIFIED	AASHTO	FRACT >3 IN (PCT)	PERCENT OF MATERIAL LESS THAN 3" PASSING SIEVE NO. 4	10	40	200	LIQUID LIMIT	PLASTICITY INDEX
0-6	FSL, L	SM-SC, SM, CL-ML, ML	A-4	0	98-100	95-100	70-90	40-65	<20	NP-7
6-30	C, CL	CH	A-7	0	98-100	95-100	90-100	70-95	51-70	34-45
30-48	WB									

DEPTH (IN.)	CLAY (PCT <2MM)	MOIST BULK DENSITY (G/CM3)	PERMEABILITY (IN/HR)	AVAILABLE WATER CAPACITY (IN/IN)	SOIL REACTION (PH)	SALINITY (MMHOS/CM)	SHRINK-SWELL POTENTIAL	EROSION FACTORS K	T	WIND EROD. GROUP	ORGANIC MATTER (PCT)	CORROSIVITY STEEL	CONCRETE
0-6	15-25		0.6-2.0	0.11-0.17	5.1-6.0	-	LOW	.43	3	-	<1	HIGH	MODERATE
6-30	35-60		<0.06	0.14-0.18	6.1-7.8	-	HIGH	.32					
30-48													

FLOODING FREQUENCY	DURATION	MONTHS	HIGH WATER TABLE DEPTH (FT)	KIND	MONTHS	CEMENTED PAN DEPTH (IN)	HARDNESS	BEDROCK DEPTH (IN)	HARDNESS	SUBSIDENCE INIT. (IN)	TOTAL (IN)	HYD GRP	POTENT'L FROST ACTION
NONE			0-1.5	PERCHED	OCT-MAY	-		20-40	SOFT	-		D	-

SANITARY FACILITIES (B)

SEPTIC TANK ABSORPTION FIELDS	SEVERE-DEPTH TO ROCK, WETNESS, PERCS SLOWLY
SEWAGE LAGOON AREAS	SEVERE-DEPTH TO ROCK, WETNESS
SANITARY LANDFILL (TRENCH)	SEVERE-DEPTH TO ROCK, WETNESS, TOO CLAYEY
SANITARY LANDFILL (AREA)	SEVERE-DEPTH TO ROCK, WETNESS
DAILY COVER FOR LANDFILL	POOR-AREA RECLAIM, TOO CLAYEY, HARD TO PACK

BUILDING SITE DEVELOPMENT (B)

SHALLOW EXCAVATIONS	SEVERE-WETNESS
DWELLINGS WITHOUT BASEMENTS	SEVERE-WETNESS, SHRINK-SWELL
DWELLINGS WITH BASEMENTS	SEVERE-WETNESS, SHRINK-SWELL
SMALL COMMERCIAL BUILDINGS	SEVERE-WETNESS, SHRINK-SWELL
LOCAL ROADS AND STREETS	SEVERE-LOW STRENGTH, WETNESS, SHRINK-SWELL
LAWNS, LANDSCAPING AND GOLF FAIRWAYS	SEVERE-WETNESS

CONSTRUCTION MATERIAL (B)

ROADFILL	POOR-AREA RECLAIM, LOW STRENGTH, WETNESS
SAND	IMPROBABLE-EXCESS FINES
GRAVEL	IMPROBABLE-EXCESS FINES
TOPSOIL	POOR-TOO CLAYEY, WETNESS

WATER MANAGEMENT (B)

POND RESERVOIR AREA	MODERATE-DEPTH TO ROCK
EMBANKMENTS DIKES AND LEVEES	SEVERE-HARD TO PACK, WETNESS
EXCAVATED PONDS AQUIFER FED	SEVERE-NO WATER
DRAINAGE	PERCS SLOWLY, DEPTH TO ROCK
IRRIGATION	WETNESS, PERCS SLOWLY, DEPTH TO ROCK
TERRACES AND DIVERSIONS	DEPTH TO ROCK, ERODES EASILY, WETNESS
GRASSED WATERWAYS	WETNESS, ERODES EASILY, DEPTH TO ROCK

REGIONAL INTERPRETATIONS

RECREATIONAL DEVELOPMENT (B)

CAMP AREAS	SEVERE-WETNESS,PERCS SLOWLY	PLAYGROUNDS	SEVERE-WETNESS,PERCS SLOWLY
PICNIC AREAS	SEVERE-WETNESS,PERCS SLOWLY	PATHS AND TRAILS	SEVERE-WETNESS,ERODES EASILY

CAPABILITY AND YIELDS PER ACRE OF CROPS AND PASTURE (HIGH LEVEL MANAGEMENT)

CLASS-DETERMINING PHASE	CAPA-BILITY		COTTON LINT (LBS)		CORN (BU)		GRAIN SORGHUM (BU)		OATS (BU)		COMMON BER-MUDAGRASS (AUM)		IMPROVED BERMUDAGR. (AUM)			
	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.
0-1%	3W		250		35		45		35		4.0		5.0			
1-3%	3E		250		30		35		35		4.0		5.0			
1-3% ER.	4E		200		20		30		30		3.0		4.0			
3-6%	4E		200		20		30		30		3.0		4.0			

WOODLAND SUITABILITY

CLASS-DETERMINING PHASE	ORD SYM	MANAGEMENT PROBLEMS					POTENTIAL PRODUCTIVITY		TREES TO PLANT
		EROSION HAZARD	EQUIP. LIMIT	SEEDLING MORT'Y.	WINDTH. HAZARD	PLANT COMPET.	COMMON TREES	SITE INDX	
							NONE		

WINDBREAKS

CLASS-DETERMIN'G PHASE	SPECIES	HT	SPECIES	HT	SPECIES	HT	SPECIES	HT
	NONE							

WILDLIFE HABITAT SUITABILITY (C)

CLASS-DETERMINING PHASE	POTENTIAL FOR HABITAT ELEMENTS								POTENTIAL AS HABITAT FOR:			
	GRAIN & SEED	GRASS & LEGUME	WILD HERB.	HARDWD TREES	CONIFER PLANTS	SHRUBS	WETLAND PLANTS	SHALLOW WATER	OPENLD WILDLF	WOODLD WILDLF	WETLAND WILDLF	RANGELD WILDLF
0-1%	FAIR	GOOD	FAIR	FAIR	-	-	FAIR	FAIR	FAIR	FAIR	FAIR	-
1-3%	FAIR	GOOD	FAIR	FAIR	-	-	POOR	POOR	FAIR	FAIR	POOR	-

POTENTIAL NATIVE PLANT COMMUNITY (RANGELAND OR FOREST UNDERSTORY VEGETATION) (D)

COMMON PLANT NAME	PLANT SYMBOL (NLSPN)	PERCENTAGE COMPOSITION (DRY WEIGHT) BY CLASS DETERMINING PHASE				
		ALL				
LITTLE BLUESTEM	ANSC2	40				
INDIANGRASS	SONU2	10				
BROWNSEED PASPALUM	PAPL3	10				
PURPLETOP	TRFL2	5				
POST OAK	QUST	5				
BLACKJACK OAK	QUMA3	5				
OTHER PERENNIAL GRASSES	PPGG	15				
OTHER PERENNIAL FORBS	PPFF	5				
OTHER TREES	TTTT	5				
POTENTIAL PRODUCTION (LBS./AC. DRY WT):						
FAVORABLE YEARS		5500				
NORMAL YEARS		4500				
UNFAVORABLE YEARS		2500				

FOOTNOTES

A ESTIMATES BASED ON ENGINEERING TEST DATA OF 1 PEDON FROM WALKER COUNTY, TEXAS.
B RATINGS BASED ON NATIONAL SOILS HANDBOOK, SEC. 403.
C WILDLIFE RATINGS BASED ON SOILS MEMORANDUM-74, JAN. 1972.
D CLAYPAN SAVANNAH RANGE SITE.

Established Series
Rev. WGC:LCB
11/78

BLEIBLERVILLE SERIES

The Bleiblerville series consists of deep, moderately well drained, very slowly permeable soils that formed from weakly consolidated calcareous clays and marls of Tertiary Age. These nearly level to gently sloping soils are on uplands. Water runs off the surface at a medium rate. Slope is dominantly 1 to 5 percent, but ranges from 0 to 5 percent.

Taxonomic Class: Fine, montmorillonitic, thermic Udic Pellusterts.

Typical Pedon: Bleiblerville clay, on a 1 percent convex slope in grass. (Colors are for dry soil unless otherwise stated. Pedon is midway between microknoll and microdepression.)

A1--0 to 33 inches; very dark gray (10YR 3/1) clay, very dark gray (10YR 3/1) moist; moderate medium angular blocky structure; extremely hard, very firm, very sticky and plastic, many fine roots; common fine pores; 1/2 inch granular mulch on surface; intersecting slickensides that begin at 8 inches are tilted 45° from horizontal and are 3 feet wide and 7 feet long; cracks 2 inches wide at the surface extend through the horizon; 9 percent calcium carbonate equivalent; calcareous; moderately alkaline; gradual wavy boundary. (4 to 48 inches thick)

A12--33 to 63 inches; dark gray (10YR 4/1) clay, dark gray (10YR 4/1) moist; moderate medium angular blocky structure; extremely hard, very firm, very sticky and plastic; few fine roots; few fine pores; large slickensides tilted 45° from horizontal and continue through the horizon; cracks extend to a depth of 50 inches; vertical streaks of dark (10YR 3/1) material in old cracks; 11 percent calcium carbonate equivalent; calcareous; moderately alkaline; abrupt wavy boundary. (8 to 36 inches thick)

AC--63 to 75 inches; pale yellow (2.5Y 8/4) clay, pale yellow (2.5Y 7/4) moist; common fine prominent dark gray (10YR 4/1) mottles; weak fine subangular blocky structure; extremely hard, very firm, sticky and plastic; few fine pores; common large slickensides; dark gray coatings on faces of slickensides; few fine concretions of calcium carbonate; 38 percent calcium carbonate equivalent; calcareous; moderately alkaline.

Type Location: Washington County, Texas; from intersection of U. S. 290 and Farm Road 1155 in Chappell Hill go 1.1 miles east on U. S. 290, then south on Farm Road 1371 for 1.25 miles, 0.2 miles west of road in hay field.

Range in Characteristics: Thickness of the combined A and AC horizons ranges from about 60 to more than 100 inches. When dry, cracks up to 3 inches wide on the surface extend to about 50 inches. Cycles of microdepressions and microknolls are repeated each 5 to 10 feet. In native grass areas, microknolls are 4 to 16 inches higher than microdepressions. Intersecting slickensides begin at 8 to 15 inches below the surface. Slickensides are several feet across and are tilted 45° to 60° from horizontal. The more tilted slickensides are near the microknolls. When dry the surface has 1/2 inch thick granular mulch. Texture is mainly clay but may be silty clay. Clay content ranges from 45 to 60 percent. Thickness of A horizons having values of 5.5 or less dry and 3.5 or less moist with chroma of 1.5 or less ranges from 4 to 22 inches over the microknoll and 20 to 48 inches in the microdepression and are more than 12 inches thick in more than 50 percent of the pedon. Chromas are less than 1.5 to depths of 20 to 60 inches in the center of microdepressions and 4 to 22 inches in the center of microknolls. The extremes of amplitude of the boundary between the A and AC horizons range from about 15 to 55 inches from the center of the microknoll to the center of the microdepression. Reaction is mildly or moderately alkaline.

The A horizons are black (10YR 2/1; 5Y 2/1), very dark gray (10YR 3/1; 5Y 3/1), dark gray (10YR 4/1; 5Y 4/1), and gray (10YR 5/1; 5Y 5/1). Most pedons have vertical streaks of darker material that are old filled cracks.

The AC horizons are pale yellow (2.5Y 7/4, 8/4), light grey (10YR 7/2; 2.5Y 7/2), very pale brown (10YR 7/3), grayish brown (10YR 5/2; 2.5Y 5/2), and light yellowish brown (2.5Y 6/4). Prominent mottles of gray, yellow, and brown range from none to common. Few to common medium soft masses or concretions of calcium carbonate are present in the lower portion. Black concretions range from none to few.

The C horizon is brownish yellow (10YR 6/6), and olive yellow (2.5Y 6/6) clay and clayey marl with common medium prominent gray mottles.

Competing Series: These are the Branyon, Burleson, Clarita, Dalco, Fairlie, Greenvine, Houston Black, Leson, Randall, San Saba, Slidell, and Watonga series in the same family and the Frelsburg and Wiergate series. Branyon soils are on terraces and have a greater length of cycle between microdepression and microknolls. Burleson and Leson soils lack the distinct granular surface mulch and are noncalcareous in the A horizon. Clarita soils have hue of 7.5YR or redder in the AC horizon. Dalco soils are 20 to 40 inches over a paralithic contact with chalk. Fairlie soils are 40 to 60 inches over a paralithic contact with chalk. Greenvine soils are 20 to 40 inches to paralithic contact with tuffaceous clays and sandstones. Houston Black soils have a longer cycle between microhigh and microlow and have broader peaks of the lower boundary of the A horizon. Randall soils are intermittently ponded in playas and are in 17 to 25 inch rainfall area. San Saba soils are less than 40 inches over hard limestone. Slidell soils contain greater amounts of calcium carbonate. Watonga soils have thinner sols and are on flood plains. Frelsburg soils have higher color values within 12 inches of the surface in 50 percent or more of the pedon. Wiergate soils are moist for longer periods of time.

Geographic Setting: Bleiblerville soils are on nearly level to gently sloping convex uplands. Slopes range from 0 to 5 percent, but are dominantly 1 to 5 percent. They formed from weakly cemented calcareous clays and marls of Tertiary age, mainly of the Fleming formation. The mean annual temperature ranges from about 64° to 70° F., with Thornthwaite P-E indices from 50 to 66. The climate is subhumid with mean annual precipitation that ranges from 35 to 45 inches.

Geographically Associated Soils: These are the competing Frelsburg and Brenham, Carbengle, and Latium series. Brenham and Carbengle soils are on nearby similar landscapes, contain large amounts of calcium carbonate, contain less clay, and lack slickensides. Frelsburg and Latium soils have dry color values of 5.5 or more within 12 inches of the surface in 50 percent of each pedon.

Drainage and Permeability: Moderately well drained; very slow internal drainage; medium runoff; very slow permeability.

Use and Vegetation: Used mainly for rangeland with small areas being cultivated to corn and grain sorghum. Most areas have been cultivated in the past. Native vegetation was mid and tall prairie grasses with a few scattered trees.

Distribution and Extent: Southeast Central Texas. This series is of moderate extent.

Series Established: Washington County, Texas; 1978.

Remarks: Properties of this soil appear to overlap those of the Houston Black series, but the two soils are on different kinds of landscapes.

Additional Data: Soil was described and sampled from 32 feet long pit. National Soil Survey Laboratory: S77TX477-4 (78P0099-78P0100). Texas A&M University Data on mineralogy is pending.

National Cooperative Soil Survey
U. S. A.

TX0003

SOIL INTERPRETATIONS RECORD

MLRA(S): 86 | BLEIBLERVILLE SERIES
REV. WGC.LCB. 3-81
UDIC PELLUSTERTS, FINE, MONTMORILLONITIC, THERMIC

THE BLEIBLERVILLE SERIES CONSISTS OF DEEP, MODERATELY WELL DRAINED, NEARLY LEVEL TO GENTLY SLOPING SOILS ON UPLANDS. THE SOIL FORMED IN CALCAREOUS CLAYS AND MARLS. IN A REPRESENTATIVE PROFILE, THE SURFACE LAYER IS VERY DARK GRAY CLAY ABOUT 33 INCHES THICK. THE NEXT LAYER, ABOUT 30 INCHES THICK, IS DARK GRAY CLAY. BELOW THIS IS PALE YELLOW CLAY. SLOPES RANGE FROM 0 TO 5 PERCENT.

ESTIMATED SOIL PROPERTIES (A)

DEPTH (IN.)	USDA TEXTURE	UNIFIED	AASHTO	FRACT >3 IN (PCT)	PERCENT OF MATERIAL LESS THAN 3" PASSING SIEVE NO. 4	10	40	200	LIQUID LIMIT	PLASTICITY INDEX
0-75	C, SIC	CH	A-7-6	0	95-100	95-100	90-100	85-100	55-85	35-60

DEPTH (IN.)	CLAY (PCT)	MOIST BULK DENSITY (G/CM3)	PERMEABILITY (IN/HR)	AVAILABLE WATER CAPACITY (IN/IN)	SOIL REACTION (PH)	SALINITY (MMHOS/CM)	SHRINK-SWELL POTENTIAL	EROSION FACTORS K	T	WIND EROD. GROUP	ORGANIC MATTER (PCT)	CORROSIVITY STEEL	CONCRETE
0-75	45-60	1.30-1.50	<0.06	0.15-0.18	7.4-8.4	-	VERY HIGH	.32	5	-	1-4	HIGH	LOW

FLOODING FREQUENCY	DURATION	MONTHS	HIGH WATER TABLE DEPTH (FT)	KIND	MONTHS	CEMENTED PAN DEPTH (IN)	HARDNESS	BEDROCK DEPTH (IN)	HARDNESS	SUBSIDENCE INIT. (IN)	TOTAL (IN)	HYD GRP	POTENT'L FROST ACTION
NONE			>6.0			-		>60		-		D	-

SANITARY FACILITIES (B)

SEPTIC TANK ABSORPTION FIELDS	SEVERE-PERCS SLOWLY
SEWAGE LAGOON AREAS	0-2%: SLIGHT 2-5%: MODERATE-SLOPE
SANITARY LANDFILL (TRENCH)	SEVERE-TOO CLAYEY
SANITARY LANDFILL (AREA)	SLIGHT.
DAILY COVER FOR LANDFILL	POOR-TOO CLAYEY,HARD TO PACK

BUILDING SITE DEVELOPMENT (B)

SHALLOW EXCAVATIONS	SEVERE-CUTBANKS CAVE
DWELLINGS WITHOUT BASEMENTS	SEVERE-SHRINK-SWELL
DWELLINGS WITH BASEMENTS	SEVERE-SHRINK-SWELL
SMALL COMMERCIAL BUILDINGS	SEVERE-SHRINK-SWELL
LOCAL ROADS AND STREETS	SEVERE-SHRINK-SWELL,LOW STRENGTH
LAWNS, LANDSCAPING AND GOLF FAIRWAYS	SEVERE-TOO CLAYEY

CONSTRUCTION MATERIAL (B)

ROADFILL	POOR-SHRINK-SWELL,LOW STRENGTH
SAND	IMPROBABLE-EXCESS FINES
GRAVEL	IMPROBABLE-EXCESS FINES
TOPSOIL	POOR-TOO CLAYEY

WATER MANAGEMENT (B)

POND RESERVOIR AREA	SLIGHT
EMBANKMENTS DIKES AND LEVEES	SEVERE-HARD TO PACK
EXCAVATED PONDS AQUIFER FED	SEVERE-NO WATER
DRAINAGE	DEEP TO WATER
IRRIGATION	0-3%: SLOW INTAKE,PERCS SLOWLY 3-5%: SLOW INTAKE,PERCS SLOWLY,SLOPE
TERRACES AND DIVERSIONS	PERCS SLOWLY
GRASSED WATERWAYS	PERCS SLOWLY

REGIONAL INTERPRETATIONS

RECREATIONAL DEVELOPMENT (B)

CAMP AREAS	MODERATE-PERC. SLOWLY,TOO CLAYEY	PLAYGROUNDS	SEVERE-TOO CLAYEY
PICNIC AREAS	MODERATE-TOO CLAYEY,PERCS SLOWLY	PATHS AND TRAILS	MODERATE-TOO CLAYEY

CAPABILITY AND YIELDS PER ACRE OF CROPS AND PASTURE (HIGH LEVEL MANAGEMENT)

CLASS-DETERMINING PHASE	CAPABILITY		CORN (BU)		GRAIN SORGHUM (BU)		IMPROVED BERMUDAGR. (AUM)									
	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.
0-1%	2W		60		75		8.0									
1-3%	2E		60		75		8.0									
3-5%	3E		45		60		6.0									

WOODLAND SUITABILITY

CLASS-DETERMINING PHASE	ORD SYM	MANAGEMENT PROBLEMS					POTENTIAL PRODUCTIVITY		TREES TO PLANT
		EROSION HAZARD	EQUIP. LIMIT	SEEDLING MORT'Y.	WINDTH. HAZARD	PLANT COMPET.	COMMON TREES	SITE INDX	
							NONE		

WINDBREAKS

CLASS-DETERMINING PHASE	SPECIES	HT	SPECIES	HT	SPECIES	HT	SPECIES	HT
	NONE							

WILDLIFE HABITAT SUITABILITY (C)

CLASS-DETERMINING PHASE	POTENTIAL FOR HABITAT ELEMENTS								POTENTIAL AS HABITAT FOR:			
	GRAIN & SEED	GRASS & LEGUME	WILD HERB.	HARDWD TREES	CONIFER PLANTS	SHRUBS	WETLAND PLANTS	SHALLOW WATER	OPENLD WILDLF	WOODLD WILDLF	WETLAND WILDLF	RANGELD WILDLF
0-3%	GOOD	GOOD	FAIR	-	-	FAIR	POOR	POOR	GOOD	-	POOR	FAIR
3-5%	FAIR	GOOD	FAIR	-	-	.FAIR	POOR	V. POOR	FAIR	-	V. POOR	FAIR

POTENTIAL NATIVE PLANT COMMUNITY (RANGELAND OR FOREST UNDERSTORY VEGETATION) (D)

COMMON PLANT NAME	PLANT SYMBOL (NLSPN)	PERCENTAGE COMPOSITION (DRY WEIGHT) BY CLASS DETERMINING PHASE				
		ALL				
LITTLE BLUESTEM	ANSC2	50				
INDIANGRASS	SONU2	10				
BIG BLUESTEM	ANGE	10				
EASTERN GAMAGRASS	TRDA3	5				
SWITCHGRASS	PAVI2	5				
OTHER PERENNIAL FORBS	PPFF	10				
OTHER SHRUBS	SSSS	5				
OTHER TREES	TTTT	5				
POTENTIAL PRODUCTION (LBS./AC. DRY WT):						
FAVORABLE YEARS		7500				
NORMAL YEARS		6000				
UNFAVORABLE YEARS		4500				

FOOTNOTES

A ESTIMATES BASED ON ENGINEERING TEST DATA OF 1 PEDON IN WASHINGTON COUNTY
B RATINGS BASED ON NATIONAL SOILS HANDBOOK, SEC. 403, 3-78.
C WILDLIFE RATINGS BASED ON SOILS MEMORANDUM-74, JAN. 1972
D BLACKLAND RANGE SITE

Established Series
Rev. BJW:JCW
3/80

BUNYAN SERIES

The Bunyan series consists of deep, well drained, moderately permeable soils that formed in stratified loamy alluvium or mixed origin. These soils are on nearly level bottomlands. Slopes range from 0 to 1 percent.

Taxonomic Class: Fine-loamy, mixed, nonacid, thermic Typic Ustifluvents.

Typical Pedon: Bunyan fine sandy loam--cultivated field.
(Colors are for dry soil unless otherwise stated.)

Ap--0 to 10 inches; light brownish gray (10YR 6/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; massive; hard, friable; few fine roots; neutral; abrupt smooth boundary. (6 to 10 inches thick)

A1--10 to 16 inches; very dark grayish brown (10YR 3/2) clay loam, very dark brown (10YR 2/2) moist; weak fine subangular blocky structure; hard, firm; few fine roots; slightly acid; abrupt smooth boundary. (0 to 8 inches thick)

C1--16 to 22 inches; grayish brown (10YR 5/2) sandy clay loam, dark grayish brown (10YR 4/2) moist; massive, breaks to fragments; thin strata of fine sandy loam and clay loam with evident bedding planes; hard, firm; few fine roots; mildly alkaline; abrupt smooth boundary. (5 to 18 inches thick)

C2--22 to 46 inches; pale brown (10YR 6/3) sandy clay loam, brown (10YR 4/3) moist; with a few fine yellowish brown mottles; massive, breaks to fragments; stratification and bedding planes as in layer above; hard, firm; few fine roots; moderately alkaline; abrupt smooth boundary. (8 to 12 inches thick)

C3--46 to 54 inches; gray (10YR 6/1) clay loam, dark gray (10YR 4/1) moist; contains a few fine yellowish brown mottles; massive; hard, firm; few ferromanganese concretions; moderately alkaline; clear smooth boundary. (6 to 12 inches thick)

C4--54 to 62 inches; gray (10YR 6/1) clay loam, gray (10YR 5/1) moist; massive; hard, firm; few concretions and masses of calcium carbonate; moderately alkaline and calcareous.

Type Location: Erath County, Texas; from the County Courthouse in Stephenville, Texas; 9.5 miles southwest on U. S. Highway 67; north on county road 0.4 mile and 150 yards east of county road in a cultivated field.

Range in Characteristics: The 10 to 40 inch control section is fine sandy loam, loam, sandy clay loam, or clay loam with 18 to 35 percent clay and more than 15 percent coarser than very fine sand. Stratification varies from scarcely evident to pronounced.

The A horizon has hue of 7.5YR or 10YR, value of 4 through 6, and chroma of 2 through 4. When moist, value is 3 and chroma is 2 or 3, the A horizon is less than 10 inches thick. Thin layers may occur below a depth of 10 inches with a color darker than the allowable range of the surface layer. The A horizon is usually fine sandy loam or loam, but is sandy clay loam or clay loam in a few pedons. It is slightly acid or neutral.

The C horizons have a hue of 7.5YR through 2.5Y, value of 4 through 6, and chroma of 2 through 4. Thin strata of very dark grayish brown, dark grayish brown, or dark brown also occur in the control section. The C3 and C4 horizons also include gray (10YR 5/1, 6/1), and light gray (10YR 7/1). The C horizons range from medium acid in the upper part through moderately alkaline and calcareous in the lower part. Interbedded strata of noncalcareous and calcareous materials are common.

Competing Series: These include the Bosque, Clairemont, Colorado, Congaree, Gowen, Loire, Pulaski, Spur, Uhland, and Yahola series. Bosque, Gowen, and Spur soils have mollic epipedons. Clairemont, Colorado, and Yahola soils are calcareous. In addition, Clairemont soils have fine-silty control sections and Yahola soils have coarse-loamy control sections. Congaree soils occur in a more moist climate and are strongly acid in some part of the 10 to 40 inch conrol section. Loire soils are calcareous and have mean annual soil temperatures of more than 72° F. Pulaski and Uhland soils have less than 18 percent clay in the 10 to 40 inch control section.

Geographic Setting: Bunyan soils are on nearly level flood plains of small streams. The soil floods rarely to commonly for brief periods during the spring and fall months. The soil formed in loamy stratified alluvium of mixed origin. The location of probable occurrence has a range of mean annual temperature of 64° to 70° F., average annual precipitation of 28 to 40 inches and Thornthwaite annual P-E indices of 40 to 64.

Geographically Associated Soils: These include the competing Bosque and Gowen series and the Duffau, May, and Windthorst series. Duffau, May, and Windthorst soils have argillic horizons and are soils of the uplands.

Drainage and Permeability: Well drained; moderately permeability. Surface runoff is slow to medium with some areas being occasionally to frequently flooded for periods of short duration.

Use and Vegetation: Most areas are being farmed in peanuts, sorghums, and pecan orchards. Areas that flood frequently are used mainly for bermuda pastures and pecan orchards.

Distribution and Extent: This soil occurs mainly in the timbered areas or north-central Texas and possibly Oklahoma. It is moderate to large extent.

Series Established: Erath County, Texas; 1970.

Remarks: These soils were formerly classified in the Alluvial great soil group.

National Cooperative Soil Survey
U. S. A.

TX0112

SOIL INTERPRETATIONS RECORD

MLRA(S): 80, 84, 82
REV. JCW, 4-80
TYPIC USTIFLUVENTS, FINE-LOAMY, MIXED, NONACID, THERMIC

BUNYAN SERIES

THE BUNYAN SERIES CONSISTS OF DEEP, WELL DRAINED, NEARLY LEVEL SOILS OF THE BOTTOMLANDS. THE SOIL FORMED IN STRATIFIED LOAMY ALLUVIUM. IN A REPRESENTATIVE PROFILE, THE SURFACE LAYER IS LIGHT BROWNISH GRAY FINE SANDY LOAM ABOUT 10 INCHES THICK. BELOW THE SURFACE LAYER AND TO A DEPTH OF 16 INCHES IS VERY DARK GRAYISH BROWN CLAY LOAM. THE NEXT LAYER IS GRAYISH BROWN TO PALE BROWN SANDY CLAY LOAM ABOUT 30 INCHES THICK. THE NEXT LAYER IS GRAY CLAY LOAM THAT EXTENDS TO 62 INCHES DEPTH. SLOPE RANGES FROM 0 TO 1 PERCENT.

ESTIMATED SOIL PROPERTIES (A)

DEPTH (IN.)	USDA TEXTURE	UNIFIED	AASHTO	FRACT >3 IN (PCT)	PERCENT OF MATERIAL LESS THAN 3" PASSING SIEVE NO. 4	10	40	200	LIQUID LIMIT	PLASTICITY INDEX
0-10	FSL, L	SM-SC, SC, CL, CL-ML	A-4, A-6	0	100	95-100	70-95	40-75	20-35	3-16
10-46	SR-CL-FSL	SC, CL	A-4, A-6	0	100	95-100	80-100	40-95	20-40	8-25
46-62	SR-CL-FSL	SC, CL	A-6, A-7	0	100	95-100	80-95	45-95	30-45	11-25

DEPTH (IN.)	CLAY (PCT <2MM)	MOIST BULK DENSITY (G/CM3)	PERMEABILITY (IN/HR)	AVAILABLE WATER CAPACITY (IN/IN)	SOIL REACTION (PH)	SALINITY (MMHOS/CM)	SHRINK-SWELL POTENTIAL	EROSION FACTORS K	T	WIND EROD. GROUP	ORGANIC MATTER (PCT)	CORROSIVITY STEEL	CONCRETE
0-10	8-25	-	2.0-6.0	0.11-0.15	6.1-7.3	-	LOW	.43	5	3	<1	MODERATE	LOW
10-46	18-35	-	0.6-2.0	0.15-0.19	5.6-8.4	-	LOW	.43					
46-62	18-35	-	0.6-2.0	0.16-0.22	6.6-8.4	-	LOW	.43					

FLOODING FREQUENCY	DURATION	MONTHS	HIGH WATER TABLE DEPTH (FT)	KIND	MONTHS	CEMENTED PAN DEPTH (IN)	HARDNESS	BEDROCK DEPTH (IN)	HARDNESS	SUBSIDENCE INIT. (IN)	TOTAL (IN)	HYD GRP	POTENT'L FROST ACTION
RARE-COMMON	BRIEF	MAY-OCT	>6.0			-		>60		-		B	-

SANITARY FACILITIES (B)

SEPTIC TANK ABSORPTION FIELDS	RARE: MODERATE-FLOODING COMMON: SEVERE-FLOODING
SEWAGE LAGOON AREAS	SEVERE-FLOODING
SANITARY LANDFILL (TRENCH)	RARE: MODERATE-FLOODING,TOO CLAYEY COMMON: SEVERE-FLOODING
SANITARY LANDFILL (AREA)	RARE: MODERATE-FLOODING COMMON: SEVERE-FLOODING
DAILY COVER FOR LANDFILL	FAIR-TOO CLAYEY

BUILDING SITE DEVELOPMENT (B)

SHALLOW EXCAVATIONS	RARE: SLIGHT COMMON: MODERATE-FLOODING
DWELLINGS WITHOUT BASEMENTS	SEVERE-FLOODING
DWELLINGS WITH BASEMENTS	SEVERE-FLOODING
SMALL COMMERCIAL BUILDINGS	SEVERE-FLOODING
LOCAL ROADS AND STREETS	RARE: SEVERE-LOW STRENGTH COMMON: SEVERE-LOW STRENGTH,FLOODING
LAWNS, LANDSCAPING AND GOLF FAIRWAYS	RARE: SLIGHT OCCAS: MODERATE-FLOODING FREQ: SEVERE-FLOODING

CONSTRUCTION MATERIAL (B)

ROADFILL	POOR-LOW STRENGTH
SAND	IMPROBABLE-EXCESS FINES
GRAVEL	IMPROBABLE-EXCESS FINES
TOPSOIL	GOOD

WATER MANAGEMENT

POND RESERVOIR AREA	MODERATE-SEEPAGE
EMBANKMENTS DIKES AND LEVEES	MODERATE-PIPING
EXCAVATED PONDS AQUIFER FED	SEVERE-NO WATER
DRAINAGE	DEEP TO WATER
IRRIGATION	RARE: SOIL BLOWING,ERODES EASILY COMMON: SOIL BLOWING,ERODES EASILY,FLOODING
TERRACES AND DIVERSIONS	ERODES EASILY,SOIL BLOWING
GRASSED WATERWAYS	ERODES EASILY

REGIONAL INTERPRETATIONS

RECREATIONAL DEVELOPMENT (B)

CAMP AREAS	SEVERE-FLOODING	PLAYGROUNDS	RARE: SLIGHT OCCAS: MODERATE-FLOODING FREQ: SEVERE-FLOODING
PICNIC AREAS	RARE,OCCAS: SLIGHT COMMON: MODERATE-FLOODING	PATHS AND TRAILS	RARE: SLIGHT OCCAS: SLIGHT FREQ: MODERATE-FLOODING

CAPABILITY AND YIELDS PER ACRE OF CROPS AND PASTURE (HIGH LEVEL MANAGEMENT)

CLASS-DETERMINING PHASE	CAPABILITY		PEANUTS (LBS)		GRAIN SORGHUM (BU)		OATS (BU)		COTTON LINT (LBS)		IMPROVED BERMUDAGR. (AUM)					
	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.
RARE	I		1400		70		60		500		8.0					
OCCAS	2W		1200		70		50		500		8.0					
FREQ	5W		-		-		-		-		6.0					

WOODLAND SUITABILITY

CLASS-DETERMINING PHASE	ORD SYM	MANAGEMENT PROBLEMS					POTENTIAL PRODUCTIVITY		TREES TO PLANT
		EROSION HAZARD	EQUIP. LIMIT	SEEDLING MORT'Y.	WINDTH. HAZARD	PLANT COMPET.	COMMON TREES	SITE INDX	
							NONE		

WINDBREAKS

CLASS-DETERMIN'G PHASE	SPECIES	HT	SPECIES	HT	SPECIES	HT	SPECIES	HT
	NONE							

WILDLIFE HABITAT SUITABILITY (C)

CLASS-DETERMINING PHASE	POTENTIAL FOR HABITAT ELEMENTS								POTENTIAL AS HABITAT FOR:			
	GRAIN & SEED	GRASS & LEGUME	WILD HERB.	HARDWD TREES	CONIFER PLANTS	SHRUBS	WETLAND PLANTS	SHALLOW WATER	OPENLD WILDLF	WOODLD WILDLF	WETLAND WILDLF	RANGELD WILDLF
RARE	GOOD	GOOD	GOOD	-	-	GOOD	POOR	V. POOR	GOOD	-	V. POOR	GOOD
OCCAS	GOOD	GOOD	GOOD	-	-	GOOD	POOR	V. POOR	GOOD	-	V. POOR	GOOD
FREQ	V. POOR	POOR	FAIR	-	-	GOOD	POOR	V. POOR	POOR	-	V. POOR	FAIR

POTENTIAL NATIVE PLANT COMMUNITY (RANGELAND OR FOREST UNDERSTORY VEGETATION) (D)

COMMON PLANT NAME	PLANT SYMBOL (NLSPN)	PERCENTAGE COMPOSITION (DRY WEIGHT) BY CLASS DETERMINING PHASE				
		ALL				
BIG BLUESTEM	ANGE	10				
LITTLE BLUESTEM	ANSC2	10				
SWITCHGRASS	PAVI2	15				
INDIANGRASS	SONU2	20				
TALL DROPSEED	SPAS	5				
TEXAS NEEDLEGRASS	STLE5	5				
SIDEOATS GRAMA	BOCU	5				
VINE-MESQUITE	PAOB	5				
OTHER PERENNIAL GRASSES	PPGG	10				
OTHER TREES	TTTT	10				
OTHER PERENNIAL FORBS	PPFF	5				
POTENTIAL PRODUCTION (LBS./AC. DRY WT): FAVORABLE YEARS		6500				
NORMAL YEARS		5000				
UNFAVORABLE YEARS		3500				

FOOTNOTES

A ESTIMATES BASED ON ENGINEERING TEST DATA OF SIMILAR SOILS. THE 0 TO 10 INCH LAYER INCLUDES ML AND SM.
B RATINGS BASED ON NSH, PART II, SECTION 403, 9-78.
C WILDLIFE RATINGS BASED ON SOILS MEMORANDUM-74, JAN. 1972.
D LOAMY BOTTOMLAND RANGE SITE.

Established Series
Rev. RGC:JJC:LCB
11/78

BURLEWASH SERIES

The Burlewash series consists of well drained. very slowly permeable soils on uplands. These soils formed in materials weathered from tuffaceous sandstone or siltstone and have a paralithic contact at a depth of 20 to 40 inches. Slopes range from 1 to 20 percent.

Taxonomic Class: Fine. montmorillonitic. thermic Ultic Paleustalfs.

Typical Pedon: Burlewash fine sandy loam. on a convex 3 percent slope. in wooded rangeland.
(Colors are for dry soil unless otherwise stated.)

A1--0 to 6 inches; light brownish gray (10YR 6/2) fine sandy loam. dark grayish brown (10YR 4/2) moist; massive; hard. friable; slightly sticky and nonplastic; very strongly acid; abrupt smooth boundary. (4 to 10 inches thick)

B2t--6 to 21 inches; brown (7.5YR 5/2) clay. dark brown (7.5YR 4/2) moist; weak medium angular blocky structure; very hard. very firm. very sticky and very plastic; many clay films on faces of peds; very strongly acid; clear smooth boundary. (12 to 23 inches thick)

B3--21 to 27 inches; brown (10YR 5/3) clay loam; dark brown (10YR 4/3) moist; few fine faint very pale brown mottles; weak medium angular blocky structure; hard. firm. sticky and plastic; patchy clay films on faces of peds; very strongly acid; clear irregular boundary. (0 to 8 inches thick)

Cr--27 to 40 inches; white (10YR 8/2) thinly bedded tuffaceous sandstone. light brownish gray (10YR 6/2) moist; few fine distinct brownish yellow mottles; few dark grayish brown mottles.

Type Location: Washington County. Texas; from intersection of Farm Roads 2780 and 1697. 0.7 mile west of Burton Texas. go 6.3 miles west on Farm Road 2780; 0.2 mile west of entrance to Goodrich Ranch; 100 feet southwest of road fence in pasture.

Range in Characteristics: Solum thickness ranges from 20 to 40 inches. and corresponds to depth to a paralithic contact with tuffaceous sandstone. or siltstone. Base saturation is typically about 50 percent but ranges from 35 to 75 percent throughout the argillic horizon. The mottles of chroma 2 in the matrix of the argillic horizon are inherited from the parent material. COLE exceeds 0.09 in the Bt horizon; however. the potential linear extensibility is less than 6 cm. Content of siliceous pebbles ranges from none to few throughout the control section.

The A horizon has hue of 10YR. value of 5 to 7. and chroma of 2 or 3. Where values are 5. the horizon is less than 7 inches thick. The A horizon is mainly fine sandy loam but ranges to loamy sand or gravelly sandy loam. Reaction ranges from medium acid to very strongly acid.

The B2t horizon has hues of 5YR or 7.5YR. values of 4 to 6. and chromas of 2 to 4. Mottles of brownish yellow or yellowish brown range from none to few. The Bt horizon is clay or sandy clay. Structure is weak or moderate. medium angular blocky. Reaction of the Bt horizon ranges from strongly acid to extremely acid.

The B3 horizon has hues of 10YR or 7.5YR. values of 4 to 6. and chromas of 2 or 3. Mottles in shades of brown or yellow range from few to common. It is clay. clay loam. or sandy clay loam. Reaction is very strongly acid or strongly acid.

The Cr horizon consists of beds of tuffaceous siltstone. sandstone. and tuffaceous clay. stratified with layers of fine sandy loam. Colors are variable with shades of gray. brown. and yellow predominating.

Competing Series: There are no competing series is the same family. Other competing series are the Arol. Arriola. Axtell. Crockett. Darst. Falba. Jedd. Lufkin. Rosanky. and Travis. Arol soils have an aquic moisture regime and range from medium acid to mildly alkaline in the B horizon. Arriola soils have udic moisture regimes. Axtell. Crocket. Darst. Lufkin. and Travis soils lack paralithic contacts. In addition. Axtell and Crockett soils have mottled upper Bt horizons. and Lufkin soils are dominated by low chroma colors that are due to wetness. Darst and Travis soils have mixed mineralogy. Falba soils have an aquic moisture regime. Jedd soils lack a paralithic contact. have mixed mineralogy. and contain more than 30 percent sandstone fragments in the A horizon. Rosanky soils lack a paralithic contact and have mixed mineralogy.

Geographic Setting: Burlewash soils occur on gently sloping to moderately steep plane to convex uplands. Slopes are mainly 3 to 5 percent but range from 1 to 20 percent. These soils formed from tuffaceous sandstones. siltstones. clays. and ash beds of the Catahoula and associated formations of Miocene age. Average annual precipitation ranges from 35 to 45 inches. Mean annual temperature ranges from about 64° to 70° F.. with Thornthwaite P-E indices ranging from 48 to 64.

Geographically Associated Soils: These are the competing Arol. Axtell. Falba. and Lufkin series and the Koether. Renburg. and Shalba series. Arol. Falba. and Lufkin soils are on nearby flatter areas. Axtell soils are on nearby higher and smoother areas. Koether soils have a lithic contact within 20 inches and are on similar slopes. Renburg soils are on nearby slopes and have a loamy argillic horizon. Shalba soils are on similar positions and have a solum that is less than 20 inches thick.

Drainage and Permeability: Well drained. Runoff is medium to rapid. Permeability is very slow.

Use and Vegetation: Used for improved pasture or range. Native vegetation is scattered post oak. blackjack oak. cedar. and yaupon. with an understory of mid and tall prairie grasses.

Distribution and Extent: Mainly in eastern and south-central Texas. The soil is moderately extensive.

Series Established: Washington County. Texas; 1978.

Remarks: Base saturation by field kits for 2 pedons indicate 56 and 54 percent base saturation with CEC of 7 to 24 meq/100g of soil. Very similar soils in Brazos County. Texas were mapped in a Lufkin-Edge complex.

National Cooperative Soil Survey
U. S. A.

TX0798

SOIL INTERPRETATIONS RECORD

MLRA(S): 87
REV. JJC,LCB, 4-81
ULTIC PALEUSTALFS, FINE, MONTMORILLONITIC, THERMIC

BURLEWASH SERIES

THE BURLEWASH SERIES CONSISTS OF MODERATELY DEEP, WELL DRAINED, GENTLY SLOPING TO MODERATELY STEEP SOILS OF UPLANDS. IN A REPRESENTATIVE PROFILE, THE SURFACE LAYER IS LIGHT BROWNISH GRAY FINE SANDY LOAM ABOUT 6 INCHES THICK. THE NEXT LAYER, FROM 6 TO 21 INCHES, IS BROWN CLAY. BELOW THIS, FROM 21 TO 27 INCHES IS BROWN CLAY LOAM. BELOW 27 INCHES IS INTERBEDDED TUFFACEOUS SANDSTONES AND SILTSTONES. SLOPES RANGE FROM 1 TO 20 PERCENT.

ESTIMATED SOIL PROPERTIES (A)

DEPTH (IN.)	USDA TEXTURE	UNIFIED	AASHTO	FRACT >3 IN (PCT)	PERCENT OF MATERIAL LESS THAN 3" PASSING SIEVE NO. 4	10	40	200	LIQUID LIMIT	PLASTICITY INDEX
0-6	FSL	SM, ML, SM-SC, CL-ML	A-4	0	90-100	70-100	70-95	40-60	<20	NP-7
0-6	LFS	SM	A-2-4, A-4	0	90-100	90-100	70-95	15-40	<20	NP-3
0-6	GR-SL	SM, SM-SC	A-2-4, A-4	0	75-85	70-80	60-75	30-48	<20	NP-7
6-21	C, SC	CL, CH	A-7	0	95-100	95-100	90-100	51-90	41-55	20-30
21-27	CL, SCL, C	CL	A-6, A-7	0	95-100	95-100	75-95	51-75	35-45	18-25
27-40	UWB									

DEPTH (IN.)	CLAY (PCT)	MOIST BULK DENSITY (G/CM3)	PERMEABILITY (IN/HR)	AVAILABLE WATER CAPACITY (IN/IN)	SOIL REACTION (PH)	SALINITY (MMHOS/CM)	SHRINK-SWELL POTENTIAL	EROSION FACTORS K	T	WIND EROD. GROUP	ORGANIC MATTER (PCT)	CORROSIVITY STEEL	CONCRETE
0-6	5-15	1.30-1.45	0.6-2.0	0.11-0.15	4.5-6.0	-	LOW	.43	2	-	<1	HIGH	HIGH
0-6	2-10	1.30-1.45	2.0-6.0	0.05-0.10	4.5-6.0	-	LOW	.37	2	-	<1		
0-6	10-19	1.30-1.45	0.6-2.0	0.11-0.15	4.5-6.0	-	LOW	.28	2	-	<1		
6-21	40-50	1.30-1.45	<0.06	0.12-0.18	4.6-5.5	-	HIGH						
21-27	30-45	1.30-1.45	0.2-0.6	0.12-0.18	4.5-5.5	-	HIGH						
27-40													

FLOODING FREQUENCY	DURATION	MONTHS	HIGH WATER TABLE DEPTH (FT)	KIND	MONTHS	CEMENTED PAN DEPTH (IN)	HARDNESS	BEDROCK DEPTH (IN)	HARDNESS	SUBSIDENCE INIT. (IN)	TOTAL (IN)	HYD GRP	POTENT'L FROST ACTION
NONE			>6.0			-		20-40	SOFT	-		D	-

SANITARY FACILITIES (2)

SEPTIC TANK ABSORPTION FIELDS	1-15%: SEVERE-PERCS SLOWLY,DEPTH TO ROCK 15+%: SEVERE-PERCS SLOWLY,DEPTH TO ROCK,SLOPE
SEWAGE LAGOON AREAS	1-7%: SEVERE-DEPTH TO ROCK 7+%: SEVERE-DEPTH TO ROCK,SLOPE
SANITARY LANDFILL (TRENCH)	1-15%: SEVERE-DEPTH TO ROCK,TOO CLAYEY 15+%: SEVERE-DEPTH TO ROCK,SLOPE,TOO CLAYEY
SANITARY LANDFILL (AREA)	1-15%: SEVERE-DEPTH TO ROCK 15+%: SEVERE-DEPTH TO ROCK,SLOPE
DAILY COVER FOR LANDFILL	POOR-AREA RECLAIM,TOO CLAYEY,HARD TO PACK

CONSTRUCTION MATERIAL (2)

ROADFILL	POOR-AREA RECLAIM,LOW STRENGTH,SHRINK-SWELL
SAND	IMPROBABLE-EXCESS FINES
GRAVEL	IMPROBABLE-EXCESS FINES
TOPSOIL	1-15%: POOR-TOO CLAYEY 15+%: POOR-TOO CLAYEY,SLOPE

BUILDING SITE DEVELOPMENT (2)

SHALLOW EXCAVATIONS	1-8%: MODERATE-TOO CLAYEY,DEPTH TO ROCK 8-15%: MODERATE-TOO CLAYEY,SLOPE, DEPTH TO ROCK 15+%: SEVERE-SLOPE
DWELLINGS WITHOUT BASEMENTS	1-15%: SEVERE-SHRINK-SWELL 15+%: SEVERE-SHRINK-SWELL,SLOPE
DWELLINGS WITH BASEMENTS	1-15%: SEVERE-SHRINK-SWELL 15+%: SEVERE-SHRINK-SWELL,SLOPE
SMALL COMMERCIAL BUILDINGS	1-8%: SEVERE-SHRINK-SWELL 8+%: SEVERE-SHRINK-SWELL,SLOPE
LOCAL ROADS AND STREETS	1-15%: SEVERE-SHRINK-SWELL,LOW STRENGTH 15+%: SEVERE-SHRINK-SWELL,SLOPE,LOW STRENGTH
LAWNS, LANDSCAPING AND GOLF FAIRWAYS	1-6%: MODERATE-THIN LAYER 6-15%: MODERATE-SLOPE,THIN LAYER 15+%: SEVERE-SLOPE

WATER MANAGEMENT (2)

POND RESERVOIR AREA	1-3%: MODERATE-DEPTH TO ROCK 3-8%: MODERATE-DEPTH TO ROCK,SLOPE 8+%: SEVERE-SLOPE
EMBANKMENTS DIKES AND LEVEES	SEVERE-THIN LAYER
EXCAVATED PONDS AQUIFER FED	SEVERE-NO WATER
DRAINAGE	DEEP TO WATER
IRRIGATION	FSL,GR-SL: PERCS SLOWLY,DEPTH TO ROCK, ERODES EASILY LFS: FAST INTAKE,PERCS SLOWLY,DEPTH TO ROCK
TERRACES AND DIVERSIONS	1-8%: DEPTH TO ROCK,ERODES EASILY, PERCS SLOWLY 8+%: SLOPE,DEPTH TO ROCK,ERODES EASILY
GRASSED WATERWAYS	1-8%: ERODES EASILY,DEPTH TO ROCK, PERCS SLOWLY 8+%: SLOPE,ERODES EASILY,DEPTH TO ROCK

REGIONAL INTERPRETATIONS

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RECREATIONAL DEVELOPMENT (B)

CAMP AREAS	1-8% FSL,LFS: MODERATE-PERCS SLOWLY 8-15%: MODERATE-PERCS SLOWLY,SLOPE 15-20%: SEVERE-SLOPE	PLAYGROUNDS	1-8% FSL,LFS: MODERATE-PERCS SLOWLY, DEPTH TO ROCK 1-8% GR: SEVERE-SMALL STONES 8-20% FSL,LFS: SEVERE-SLOPE 8-20% GR: SEVERE-SLOPE,SMALL STONES
PICNIC AREAS	1-8% FSL,LFS: MODERATE-PERCS SLOWLY 8-15%: MODERATE-PERCS SLOWLY,SLOPE 15-20%: SEVERE-SLOPE	PATHS AND TRAILS	SEVERE-ERODES EASILY

CAPABILITY AND YIELDS PER ACRE OF CROPS AND PASTURE (HIGH LEVEL MANAGEMENT)

CLASS-DETERMINING PHASE	CAPABILITY		IMPROVED BERMUDAGR. (AUM)											
	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.
1-5%	[illegible]		[illegible]											
5-20%	4E		[illegible]											

WOODLAND SUITABILITY

CLASS-DETERMINING PHASE	ORD SYM	MANAGEMENT PROBLEMS					POTENTIAL PRODUCTIVITY		TREES TO PLANT
		EROSION HAZARD	EQUIP. LIMIT	SEEDLING MORTY.	WINDTH. HAZARD	PLANT COMPET.	COMMON TREES	SITE INDX	
							NONE		

WINDBREAKS

CLASS-DETERMINING PHASE	SPECIES	HT	SPECIES	HT	SPECIES	HT	SPECIES	HT
	NONE							

WILDLIFE HABITAT SUITABILITY (C)

CLASS-DETERMINING PHASE	POTENTIAL FOR HABITAT ELEMENTS								POTENTIAL AS HABITAT FOR:			
	GRAIN & SEED	GRASS & LEGUME	WILD HERB.	HARDWD TREES	CONIFER PLANTS	SHRUBS	WETLAND PLANTS	SHALLOW WATER	OPENLD WILDLF	WOODLD WILDLF	WETLAND WILDLF	RANGELD WILDLF
1-5%	FAIR	GOOD	GOOD	-	-	GOOD	POOR	V. POOR	GOOD	-	V. POOR	GOOD
5-20%	POOR	FAIR	GOOD	-	-	GOOD	V. POOR	V. POOR	FAIR	-	V. POOR	GOOD

POTENTIAL NATIVE PLANT COMMUNITY (RANGELAND OR FOREST UNDERSTORY VEGETATION) (D)

COMMON PLANT NAME	PLANT SYMBOL (NLSPN)	PERCENTAGE COMPOSITION (DRY WEIGHT) BY CLASS DETERMINING PHASE				
		ALL				
LITTLE BLUESTEM	ANSC2	30				
INDIANGRASS	SONU2	5				
SWITCHGRASS	PAVI2	10				
BIG BLUESTEM	ANGE	5				
PURPLETOP	TRFL2	5				
BROWNSEED PASPALUM	PAPL3	5				
BEAKED PANICUM	PAAN	5				
POST OAK	QUST	15				
BLACKJACK OAK	QUMA3	10				
YAUPON	ILVO	5				
AMERICAN BEAUTYBERRY	CAAM2	4				
POTENTIAL PRODUCTION (LBS./AC. DRY WT):						
FAVORABLE YEARS		4500				
NORMAL YEARS		3000				
UNFAVORABLE YEARS		2000				

FOOTNOTES

A ESTIMATES BASED ON TEST DATA OF 2 PEDONS FROM WASHINGTON COUNTY,TEXAS
B RATINGS BASED ON NATIONAL SOILS HANDBOOK, SEC. 403.
C WILDLIFE RATINGS BASED ON SOILS MEMORANDUM-74, JAN. 1972
D CLAYPAN SAVANNAH RANGE SITE

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Established Series
Rev. WRM:LCR
3/81

FALBA SERIES

The Falba series consists of moderately deep, somewhat poorly drained, very slowly permeable soils on uplands. The soil formed in tuffaceous sandstones. They are saturated during the winter and spring. Slopes range from 0 to 8 percent.

Taxonomic Class: Fine, montmorillonitic, thermic Typic Albaqualfs.

Typical Pedon: Falba fine sandy loam--pasture.
(Colors are for moist soil unless otherwise stated.)

Ap--0 to 5 inches; brown (10YR 5/3) fine sandy loam, pale brown (10YR 6/3) dry; few fine distinct yellowish brown mottles; weak platy structure; hard, very friable; common fine roots; strongly acid; abrupt smooth boundary. (3 to 8 inches thick)

A2g--5 to 7 inches; grayish brown (10YR 5/2) fine sandy loam, light brownish gray (10YR 6/2) dry; common fine distinct yellowish brown mottles; massive; hard, very friable; few fine roots; amplitude of the contact between the A2g and the B21tg horizon is about 5 inches across a horizontal distance of two feet; very strongly acid; abrupt wavy boundary. (0 to 5 inches thick)

B21tg--7 to 17 inches; grayish brown (10YR 5/2) clay, light brownish gray (10YR 6/2) dry; common fine and medium distinct yellowish brown (10YR 5/6) mottles; few fine prominent strong brown and yellowish red mottles; weak coarse prismatic structure parting to moderate medium and fine angular blocky structure; extremely hard, very firm, very sticky and very plastic; few fine roots, some of which are concentrated between prisms; few shiny pressure faces on the peds; very strongly acid; gradual wavy boundary. (6 to 15 inches thick)

B22tg--17 to 28 inches; grayish brown (10YR 5/2) on the outside of the peds and grayish brown (2.5Y 5/2) on the inside of the peds; clay; light brownish gray (10YR 6/2) dry; few medium distinct strong brown (7.5YR 5/6) mottles associated with strongly cemented black nodules; weak coarse prismatic structure parting to moderate medium and coarse blocky structure; extremely hard, very firm, very sticky and very plastic; few fine roots between prisms; few very fine sand pockets about 1 cm in diameter between some peds; common white powdery bodies about 1 to 5 mm in diameter; few shiny pressure faces; very strongly acid; clear wavy boundary. (6 to 15 inches thick)

B23tg&Cr--28 to 33 inches; light brownish gray (2.5Y 6/2) sandy clay loam, light gray (2.5Y 7/2), dry; few medium prominent strong brown (7.5YR 5/6) mottles; the B23tg part consists of dark gray (10YR 4/1) clay flows; weak coarse and medium blocky structure with clay flows or thick continuous clay films between the blocks; very hard, very firm, somewhat brittle; few fine roots; few lenses of loam that may be partially weathered tuffaceous fine sandstone; few tuffaceous sandstone fragments from 1 to 10 cm across the long axis; few strongly cemented iron concretions up to about 1.5 cm in diameter; few soft white bodies; very strongly acid; abrupt wavy boundary. (0 to 10 inches thick)

Cr--33 to 55 inches; very pale brown (10YR 7/3) tuffaceous fine sandstone with angular fractures white (10YR 8/1) dry; weakly cemented; few fine roots along fractures in dark thin clay flows; few medium strongly cemented black concretions and few soft red and yellow bodies; very strongly acid.

Type Location: Walker County, Texas; from the intersection of Texas Highway 30 and Interstate 45 in the west edge of Huntsville, Texas; 7.75 miles west on Texas Highway 30; then north on Farm Road 2550, 4.55 miles to the intersection of Farm Road 2550 and Farm Road 1696; then 1.3 mile west on Farm Road 1696; then 1.4 mile south on Roberts Road and 1056 feet west in pasture.

Range in Characteristics: Solum thickness ranges from 20 to 40 inches and corresponds to the depth to tuffaceous sandstone, siltstone, or tuffaceous clays. The COLE may exceed 0.09 in the Btg horizons, but the potential linear extensibility of the soil is less than 6 cm. Siliceous pebbles range from none to few throughout the pedon.

The A horizon averages less than 10 inches thick in more than 50 percent of the pedons, but it is as much as 15 inches thick over subsoil troughs. The Ap horizon is brown (10YR 5/3), dark grayish brown (10YR 4/2), grayish brown (10YR 5/2; 2.5Y 5/2), light brownish gray (10YR 6/2; 2.5Y 6/2), dark gray (10YR 4/1), gray (10YR 5/1, 6/1) or light gray (10YR 7/1). The A2g horizon, where present, is one or two units of value higher then the Ap horizon. Mottles in the A horizons range from none to common. The A horizon is medium or strongly acid. The boundary between the A and Btg horizon is abrupt and ranges from smooth to wavy.

The Btg horizon is dark gray (10YR 4/1), gray (10YR 5/1, 6/1), dark grayish brown (10YR 4/2; 2.5Y 4/2), grayish brown (10YR 5/2; 2.5Y 5/2), or light brownish gray (10YR 6/2; 2.5Y 6/2). Mottles range from none to common, fine to medium, and from yellowish brown to yellowish red. The Btg horizons are clay, sandy clay loam, or clay loam, with the clay content ranging from 35 to 50 percent. White bodies of barite are present in some pedons. Reaction is strongly or very strongly acid.

The Cr layer ranges from clayey tuff, tuffaceous clay, volcanic ash, fine grained sandstone to siltstone. It is pale olive (5Y 6/3, 6/4), light olive gray (5Y 6/2), olive gray (5Y 4/2, 5/2), light gray (5Y 7/2; 2.5Y 7/1, 7/2), gray (5Y 6/1; 10YR 5/1, 6/1), light brownish gray (2.5Y 6/2), very pale brown (10YR 7/3), or pale brown (10YR 6/3). Reaction ranges from neutral through strongly acid.

Competing Series: These are the Alusa, Arol, Corrigan, Crowley, and Miekle series in the same family and the Burlewash, Cherokee, Edna, Lufkin and Shalba series in the similar families. Alusa, Cherokee, Crowley, Edna, Meikle, and Lufkin soils have sola thicker than 40 inches. Arol soils have color values less than 3.5 in the B21tg horizon and are less acid in the Btg horizon. Burlewash soils are well drained and have higher chroma colors in the Bt horizons. Corrigan soils occur in areas of higher rainfall with average summer soil moisture deficit of less than 4 inches. Shalba soils have sola less than 20 inches thick.

Geographic Setting: Falba soils are on nearly level to sloping erosional uplands. Slopes range from 1/2 to 8 percent and surfaces are plane to convex. The soils formed in interbedded clays, tuffs, ash beds, sandstones, and pyroclastics as typified by the Catahoula Formation. The mean annual precipitation ranges from 35 to 45 inches, the average annual temperature ranges from 67° to 70° F., and the Thornthwaite annual P-E indices range from 52 to 72. The average summer moisture deficit ranges from 6 to 8 inches.

Geographically Associated Soils: These are the competing Arol, Burlewash, Lufkin, and Shalba series and the Elmina series. Arol, Lufkin, and Shalba soils are on similar landscape positions. Burlewash soils are on nearby sloping, convex areas. Elmina soils have sandy surface layers 20 to 40 inches thick.

Drainage and Permeability: Somewhat poorly drained; slow to medium runoff; very slow permeability. The soil is saturated during the winter and spring months of most years.

Use and Vegetation: Mainly pastureland and rangeland. Large acreages were once planted to cotton, but are now unimproved pastures. Improved pastures are coastal bermudagrass. Native vegetation is a post oak savannah. Major grasses being little bluestem, indiangrass, switchgrass, big bluestem and sideoats grama. A few shortleaf pine have encroached this soil in the extreme eastern part of the area of occurrence.

Distribution and Extent: Southeastern and south-central Texas, mainly between the Trinity and Colorado Rivers. The series is of moderate extent.

Series Established: Walker County, Texas; 1975.

Remarks: Falba soils were formerly classified in the Planosol great soil group. They were mapped as part of the Lufkin series.

Additional Data: National Soil Survey Laboratory: 70TX-236-2(71L009-71L014).

National Cooperative Soil Survey
U. S. A.

TX0366

SOIL INTERPRETATIONS RECORD

MLRA(S): 67
REV.LCB, 11-78
TYPIC ALBAQUALFS, FINE, MONTMORILLONITIC, THERMIC

FALBA SERIES

THE FALBA SERIES CONSISTS OF MODERATELY DEEP, SOMEWHAT POORLY DRAINED, NEARLY LEVEL TO SLOPING SOILS OF UPLANDS. THE SOIL FORMED IN TUFFACEOUS MATERIALS. IN A REPRESENTATIVE PROFILE, THE SURFACE LAYER IS FINE SANDY LOAM 7 INCHES THICK: BROWN IN THE UPPER PART AND GRAYISH BROWN BELOW. THE SUBSOIL IS GRAYISH BROWN CLAY 17 INCHES THICK. THE NEXT LAYER IS LIGHT BROWNISH GRAY SANDY CLAY LOAM 9 INCHES THICK. THE SUBSTRATUM BELOW 33 INCHES IS WEAKLY CEMENTED SANDSTONE. SLOPES RANGE FROM 0 TO 8 PERCENT.

ESTIMATED SOIL PROPERTIES (A)

DEPTH (IN.)	USDA TEXTURE	UNIFIED	AASHTO	FRACT >3 IN (PCT)	PERCENT OF MATERIAL LESS THAN 3" PASSING SIEVE NO. 4	10	40	200	LIQUID LIMIT	PLASTICITY INDEX
0-7	FSL	SM-SC, SM, CL-ML, ML	A-4	0	98-100	95-100	70-98	40-60	<20	NP-7
7-24	C, CL	CH	A-7	0	98-100	95-100	90-100	75-95	51-70	34-48
24-33	SCL, CL, C	CH, CL	A-6, A-7	0	98-100	95-100	80-100	51-95	34-70	21-48
33-65	UWB									

DEPTH (IN.)	CLAY (PCT <2MM)	MOIST BULK DENSITY (G/CM3)	PERMEABILITY (IN/HR)	AVAILABLE WATER CAPACITY (IN/IN)	SOIL REACTION (PH)	SALINITY (MMHOS/CM)	SHRINK-SWELL POTENTIAL	EROSION FACTORS K	T	WIND EROD. GROUP	ORGANIC MATTER (PCT)	CORROSIVITY STEEL	CONCRETE
0-7	10-20		0.6-2.0	0.11-0.15	5.1-6.0	-	LOW	.43	2	-	.5-2	HIGH	MODERATE
7-24	35-60		<0.06	0.14-0.16	4.5-6.5	-	HIGH	.32					
24-33	35-60		<0.06	0.14-0.18	4.5-6.5	-	HIGH	.32					
33-65													

FLOODING FREQUENCY	DURATION	MONTHS	HIGH WATER TABLE DEPTH (FT)	KIND	MONTHS	CEMENTED PAN DEPTH (IN)	HARDNESS	BEDROCK DEPTH (IN)	HARDNESS	SUBSIDENCE INIT. (IN)	TOTAL (IN)	HYD GRP	POTENT'L FROST ACTION
NONE			0-1.5	PERCHED	OCT-MAY	-		20-40	SOFT	-		D	-

SANITARY FACILITIES (B)

SEPTIC TANK ABSORPTION FIELDS	SEVERE-DEPTH TO ROCK, WETNESS, PERCS SLOWLY
SEWAGE LAGOON AREAS	0-7%: SEVERE-DEPTH TO ROCK, WETNESS 7+%: SEVERE-DEPTH TO ROCK, SLOPE, WETNESS
SANITARY LANDFILL (TRENCH)	SEVERE-DEPTH TO ROCK, WETNESS, TOO CLAYEY
SANITARY LANDFILL (AREA)	SEVERE-DEPTH TO ROCK, WETNESS
DAILY COVER FOR LANDFILL	POOR-AREA RECLAIM, TOO CLAYEY, HARD TO PACK

CONSTRUCTION MATERIAL (B)

ROADFILL	POOR-AREA RECLAIM, LOW STRENGTH, WETNESS
SAND	IMPROBABLE-EXCESS FINES
GRAVEL	IMPROBABLE-EXCESS FINES
TOPSOIL	POOR-TOO CLAYEY, WETNESS

WATER MANAGEMENT (B)

POND RESERVOIR AREA	0-3%: MODERATE-DEPTH TO ROCK 3-8%: MODERATE-DEPTH TO ROCK, SLOPE
EMBANKMENTS DIKES AND LEVEES	SEVERE-HARD TO PACK, WETNESS
EXCAVATED PONDS AQUIFER FED	SEVERE-NO WATER
DRAINAGE	0-3%: PERCS SLOWLY, DEPTH TO ROCK 3+%: PERCS SLOWLY, DEPTH TO ROCK, SLOPE
IRRIGATION	WETNESS, PERCS SLOWLY, DEPTH TO ROCK
TERRACES AND DIVERSIONS	DEPTH TO ROCK, ERODES EASILY, WETNESS
GRASSED WATERWAYS	WETNESS, ERODES EASILY, DEPTH TO ROCK

BUILDING SITE DEVELOPMENT (B)

SHALLOW EXCAVATIONS	SEVERE-WETNESS
DWELLINGS WITHOUT BASEMENTS	SEVERE-WETNESS, SHRINK-SWELL
DWELLINGS WITH BASEMENTS	SEVERE-WETNESS, SHRINK-SWELL
SMALL COMMERCIAL BUILDINGS	SEVERE-WETNESS, SHRINK-SWELL
LOCAL ROADS AND STREETS	SEVERE-LOW STRENGTH, WETNESS, SHRINK-SWELL
LAWNS, LANDSCAPING AND GOLF FAIRWAYS	SEVERE-WETNESS

REGIONAL INTERPRETATIONS

FALBA SERIES TX0366

RECREATIONAL DEVELOPMENT (B)

CAMP AREAS	SEVERE-WETNESS,PERCS SLOWLY	PLAYGROUNDS	0-6%: SEVERE-WETNESS,PERCS SLOWLY 6+%: SEVERE-SLOPE,WETNESS,PERCS SLOWLY
PICNIC AREAS	SEVERE-WETNESS,PERCS SLOWLY	PATHS AND TRAILS	SEVERE-WETNESS,ERODES EASILY

CAPABILITY AND YIELDS PER ACRE OF CROPS AND PASTURE (HIGH LEVEL MANAGEMENT)

CLASS-DETERMINING PHASE	CAPABILITY		COTTON LINT (LBS)		CORN (BU)		GRAIN SORGHUM (BU)		OATS (BU)		COMMON BERMUDAGRASS (AUM)		IMPROVED BERMUDAGR. (AUM)			
	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.
0-1%	3W		150		30		45		30		4.0		5.0			
1-6%	4E		150		25		35		30		4.0		5.0			
6-8%	6E		-		-		-		-		3.5		4.5			
1-6% ER.	4E		125		15		25		25		3.0		4.0			

WOODLAND SUITABILITY

CLASS-DETERMINING PHASE	ORD SYM	MANAGEMENT PROBLEMS: EROSION HAZARD	EQUIP. LIMIT	SEEDLING MORT'Y.	WINDTH. HAZARD	PLANT COMPET.	POTENTIAL PRODUCTIVITY: COMMON TREES	SITE INDX	TREES TO PLANT
							NONE		

WINDBREAKS

CLASS-DETERMINING PHASE	SPECIES	HT	SPECIES	HT	SPECIES	HT	SPECIES	HT
	NONE							

WILDLIFE HABITAT SUITABILITY (C)

CLASS-DETERMINING PHASE	POTENTIAL FOR HABITAT ELEMENTS								POTENTIAL AS HABITAT FOR:			
	GRAIN & SEED	GRASS & LEGUME	WILD HERB.	HARDWD TREES	CONIFER PLANTS	SHRUBS	WETLAND PLANTS	SHALLOW WATER	OPENLD WILDLF	WOODLD WILDLF	WETLAND WILDLF	RANGELD WILDLF
0-1%	FAIR	GOOD	FAIR	FAIR	-	-	FAIR	FAIR	FAIR	FAIR	FAIR	-
1-6%	FAIR	GOOD	FAIR	FAIR	-	-	POOR	POOR	FAIR	FAIR-	POOR	-
6-8%	FAIR	GOOD	FAIR	FAIR	-	-	POOR	V. POOR	FAIR	FAIR	V. POOR	-

POTENTIAL NATIVE PLANT COMMUNITY (RANGELAND OR FOREST UNDERSTORY VEGETATION) (D)

COMMON PLANT NAME	PLANT SYMBOL (NLSPN)	PERCENTAGE COMPOSITION (DRY WEIGHT) BY CLASS DETERMINING PHASE: ALL				
LITTLE BLUESTEM	ANSC2	40				
INDIANGRASS	SONU2	10				
BROWNSEED PASPALUM	PAPL3	10				
PURPLETOP	TRFL2	5				
POST OAK	QUST	5				
BLACKJACK OAK	QUMA3	5				
OTHER PERENNIAL GRASSES	PPGG	15				
OTHER TREES	TTTT	5				
OTHER PERENNIAL FORBS	PPFF	5				
POTENTIAL PRODUCTION (LBS./AC. DRY WT):						
FAVORABLE YEARS		5600				
NORMAL YEARS		4000				
UNFAVORABLE YEARS		2500				

FOOTNOTES

A ESTIMATES BASED ON ENGINEERING TEST DATA OF 2 PEDONS FROM WALKER COUNTY TEXAS.
B RATINGS BASED ON NATIONAL SOILS HANDBOOK, SEC. 403.
C WILDLIFE RATINGS BASED ON SOILS MEMORANDUM-74, JAN. 1972.
D CLAYPAN SAVANNAH RANGE SITE.

Established Series
Rev. RJW:LCB
4/81

MABANK SERIES

The Mabank series consists of deep, somewhat poorly drained, very slowly permeable soils that formed from alkaline clays and shales. These soils are on smooth uplands. Slopes range from 0 to 5 percent.

Taxonomic Class: Fine, montmorillonitic, thermic Vertic Albaqualfs.

Typical Pedon: Mabank fine sandy loam--pasture.
(Colors are for dry soil unless otherwise stated.)

Ap--0 to 7 inches; grayish brown (10YR 5/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; massive; very hard, friable; many fine roots; few fine iron concretions; slightly acid; abrupt wavy boundary. (4 to 11 inches thick)

B21tg--7 to 24 inches; very dark gray (10YR 3/1) clay, black (10YR 2/1) moist; moderate medium blocky structure, extremely hard, very firm; few fine roots; patchy clay films; few pressure faces; few gypsum crystals; mildly alkaline; gradual smooth boundary. (11 to 30 inches thick)

B22tg--24 to 32 inches; gray (10YR 5/1) clay, dark gray (10YR 4/1) moist; moderate medium blocky structure; extremely hard, very firm; few fine roots; common clay films; few iron concretions; common strongly cemented $CaCO_3$ concretions; common masses of gypsum crystals; moderately alkaline; gradual smooth boundary. (6 to 30 inches thick)

B23t--32 to 50 inches; light brownish gray (10YR 6/2) clay, grayish brown (10YR 5/2) moist; few fine mottles of light olive brown; weak medium blocky structure; extremely hard, very firm; few fine roots; common clay films; many strongly cemented $CaCO_3$ concretions and gypsum crystals; few iron concretions; moderately alkaline; gradual smooth boundary. (0 to 20 inches thick)

B3--50 to 70 inches; light gray (10YR 7/2) clay, light brownish gray (10YR 6/2) moist; weak medium blocky structure; extremely hard, very firm; few fine roots; common clay films; many gypsum crystals; few iron concretions; moderately alkaline.

Type Location: Kaufman County, Texas; 2.5 miles north of the junction of Farm Market Road 985 with Griffith Road in Terrell; 0.7 mile west of Farm Market Road 985 on County Road; 250 feet south of road.

Range in Characteristics: Solum thickness ranges from 50 to more than 80 inches. Depth to carbonates that are hard and pitted ranges from 15 to 55 inches. Cracks at least 0.4 inch wide extend from the top of the Bt; horizon to a depth of 24 inches or more for 90 to 150 days (cumulative).

The A horizon averages less than 8 inches thick in more than 50 percent of the pedon, but it is as much as 11 inches thick in some part of most pedons in subsoil troughs. It is dark grayish brown (10YR 4/2), very dark gray (10YR 3/1), dark gray (10YR 4/1), grayish brown (10YR 5/2), gray (10YR 5/1, 6/1), or light brownish gray (10YR 6/2). It is fine sandy loam, silt loam, or loam and is massive and hard or very hard when dry, but has weak blocky and granular structure when moist. The boundary between the A and Btg horizon is abrupt and wavy to irregular. Reaction ranges from medium acid to neutral.

The B21tg horizon is dark gray (10YR 4/1), or very dark gray (10YR 3/1; N 3/0). It is clay loam or clay, and contains 35 to 50 percent clay and is medium acid through mildly alkaline.

The lower B2tg horizons are grayish brown (10YR 5/2; 2.5Y 5/2), light brownish gray (10YR 6/2; 2.5Y 6/2), light gray (10YR 7/1, 7/2; 2.5YR 7/2), gray (10YR 5/1, 6/1), or dark gray (10YR 5/1), and contain a few fine mottles of brown, light olive brown, light brownish gray, light yellowish brown, or reddish brown in most pedons. They are medium acid through moderately alkaline.

The B3 horizon is grayish brown, light brownish gray, gray, or light gray with mottles of pale olive, olive yellow, or light olive brown. It is clay or shaly clay. $CaCO_3$ concretions, iron concretions, and gypsum crystals are present in some pedons. Also some pedons contain a few quartz pebbles. Some have a few slickensides that do not intersect.

A IIC horizon is present below 60 inches in some pedons.

Competing Series: These are the Anacoco, Alusa, Axtell, Baldwin, Bonham, Crockett, Crowley, Edna, Forestdale, Lufkin, Mayhew, Meggett, Midland, Normangee, Wilson, and Wrightsville series. Alusa and Forestdale soils have COLE values less than 0.09. Anacoco soils have strongly or very strongly acid Bt horizons. Axtell, Crockett, and Normangee soils lack dominant chromas of 2 or less in the Bt horizon. Baldwin, Forestdale, Mayhew, Midland, and Wilson soils lack an abrupt textural change between the A and Btg horizons. Bonham soils have mollic epipedons. Crowley soils have A horizons more than 12 inches thick and have moist values of 4 or more in the upper Bt horizon. Edna and Lufkin soils have dry values of 5 or more or moist values of 4 or more throughout the upper Btg horizons and, in addition, Lufkin soils have a solum thickness of less than 60 inches and Edna soils have mottled upper Btg horizons. Meggett soils have COLE values of less than 0.09 and have mixed mineralogy. Wrightsville soils have tongues of A2g horizon extending into the Btg horizon.

Geographic Setting: Mabank soils are on nearly level to gently sloping uplands. Slopes are generally less than 2 percent, but range from 0 to 5 percent. The soil formed in alkaline marine clays and shales. The mean annual temperature is 64° to 70° F. Average annual precipitation is 32 to 45 inches and Thornthwaite annual P-E indices are 50 to 70.

Geographically Associated Soils: These are the competing Axtell, Bonham, Crockett, Normangee, and Wilson series and the Burleson, Heiden, and Houston Black series. Burleson, Heiden, and Houston Black soils are clayey throughout and have intersecting slickensides.

Drainage and Permeability: Somewhat poorly drained; very slow to medium surface runoff; very slow internal drainage; very slow permeability.

Use and Vegetation: Used for growing corn, cotton, grain sorghums, and small grain, but much of the acreage is now idle. Native vegetation is tall prairie grasses such as little bluestem, indiangrass, switchgrass, and gramas; and scattered elm, hackberry, mesquite, and honey locust trees.

Distribution and Extent: Mainly in the Blackland Prairies and Texas Claypan areas of Central Texas. The series is moderately extensive.

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Mabank Series

Series Established: Caldwell County, Texas; 1972.

Remarks: These soils formerly were included in Wilson series.

National Cooperative Soil Survey
U. S. A.

TX0102

SOIL INTERPRETATIONS RECORD

MLRA(S): 86, 87
REV. BJW-LCB, 3-81
VERTIC ALBAQUALFS, FINE, MONTMORILLONITIC, THERMIC

MABANK SERIES

THESE ARE DEEP, SOMEWHAT POORLY DRAINED, VERY SLOWLY PERMEABLE SOILS. THESE SOILS OCCUPY NEARLY LEVEL TO GENTLY SLOPING UPLANDS. THE SOILS FORMED IN ALKALINE MARINE CLAYS AND SHALES. THESE SOILS HAVE THIN GRAYISH BROWN FINE SANDY LOAM UPPER LAYERS ABOUT 7 INCHES THICK OVER CLAY THAT IS VERY DARK GRAY IN THE UPPER PART AND LIGHT BROWNISH GRAY OR LIGHT GRAY MOTTLED WITH LIGHT OLIVE BROWN IN THE LOWER PART. SLOPES RANGE FROM 0 TO 3 PERCENT.

ESTIMATED SOIL PROPERTIES (A)

DEPTH (IN.)	USDA TEXTURE	UNIFIED	AASHTO	FRACT >3 IN (PCT)	PERCENT OF MATERIAL LESS THAN 3" PASSING SIEVE NO. 4	10	40	200	LIQUID LIMIT	PLASTICITY INDEX
0-7	FSL, L, SIL	CL, CL-ML, SM-SC, SC	A-4	0	95-100	95-100	90-98	40-70	16-32	4-15
7-70	C, CL	CH, CL	A-7, A-6	0	98-100	95-100	95-100	80-95	38-55	22-37

DEPTH (IN.)	CLAY (PCT)	MOIST BULK DENSITY (G/CM3)	PERMEABILITY (IN/HR)	AVAILABLE WATER CAPACITY (IN/IN)	SOIL REACTION (PH)	SALINITY (MMHOS/CM)	SHRINK-SWELL POTENTIAL	EROSION FACTORS K	T	WIND EROD. GROUP	ORGANIC MATTER (PCT)	CORROSIVITY STEEL	CONCRETE
0-7	10-25		0.6-2.0	0.11-0.15	5.6-7.3	-	LOW	.43	5	-	1-2	HIGH	MODERATE
7-70	35-60		<0.06	0.12-0.18	5.6-8.4	-	HIGH	.32					

FLOODING FREQUENCY	DURATION	MONTHS	HIGH WATER TABLE DEPTH (FT)	KIND	MONTHS	CEMENTED PAN DEPTH (IN)	HARDNESS	BEDROCK DEPTH (IN)	HARDNESS	SUBSIDENCE INIT. (IN)	TOTAL (IN)	HYD GRP	POTENT'L FROST ACTION
NONE			0.0-1.0	PERCHED	DEC-MAR	-		>60		-		D	-

SANITARY FACILITIES (B)

SEPTIC TANK ABSORPTION FIELDS	SEVERE-WETNESS,PERCS SLOWLY
SEWAGE LAGOON AREAS	SEVERE-WETNESS
SANITARY LANDFILL (TRENCH)	SEVERE-WETNESS,TOO CLAYEY
SANITARY LANDFILL (AREA)	SEVERE-WETNESS
DAILY COVER FOR LANDFILL	POOR-TOO CLAYEY,HARD TO PACK,WETNESS

BUILDING SITE DEVELOPMENT (B)

SHALLOW EXCAVATIONS	SEVERE-WETNESS
DWELLINGS WITHOUT BASEMENTS	SEVERE-WETNESS,SHRINK-SWELL
DWELLINGS WITH BASEMENTS	SEVERE-WETNESS,SHRINK-SWELL
SMALL COMMERCIAL BUILDINGS	SEVERE-WETNESS,SHRINK-SWELL
LOCAL ROADS AND STREETS	SEVERE-LOW STRENGTH,WETNESS,SHRINK-SWELL
LAWNS, LANDSCAPING AND GOLF FAIRWAYS	SEVERE-WETNESS

CONSTRUCTION MATERIAL (B)

ROADFILL	POOR-LOW STRENGTH,WETNESS,SHRINK-SWELL
SAND	IMPROBABLE-EXCESS FINES
GRAVEL	IMPROBABLE-EXCESS FINES
TOPSOIL	POOR-TOO CLAYEY,WETNESS

WATER MANAGEMENT (B)

POND RESERVOIR AREA	SLIGHT
EMBANKMENTS DIKES AND LEVEES	SEVERE-WETNESS
EXCAVATED PONDS AQUIFER FED	SEVERE-NO WATER
DRAINAGE	0-3%: PERCS SLOWLY 3+%: PERCS SLOWLY,SLOPE
IRRIGATION	0-3%: WETNESS,PERCS SLOWLY 3+%: WETNESS,PERCS SLOWLY,SLOPE
TERRACES AND DIVERSIONS	ERODES EASILY,WETNESS,PERCS SLOWLY
GRASSED WATERWAYS	WETNESS,ERODES EASILY,PERCS SLOWLY

REGIONAL INTERPRETATIONS

RECREATIONAL DEVELOPMENT (B)

CAMP AREAS	SEVERE-WETNESS,PERCS SLOWLY	PLAYGROUNDS	SEVERE-WETNESS,PERCS SLOWLY
PICNIC AREAS	SEVERE-WETNESS,PERCS SLOWLY	PATHS AND TRAILS	SEVERE-WETNESS

CAPABILITY AND YIELDS PER ACRE OF CROPS AND PASTURE (HIGH LEVEL MANAGEMENT)

CLASS-DETERMINING PHASE	CAPA-BILITY		COTTON LINT (LBS)		GRAIN SORGHUM (BU)		CORN (BU)		IMPROVED BERMUDAGR. (AUM)							
	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.
0-1%	3W		350		55		40		6							
1-3%	3E		300		45		35		6							
3-5%	3E		250		40		30		5							
1-5% ERODED	4E		200		35		-		5							

WOODLAND SUITABILITY

CLASS-DETERMINING PHASE	ORD SYM	MANAGEMENT PROBLEMS					POTENTIAL PRODUCTIVITY		TREES TO PLANT
		EROSION HAZARD	EQUIP. LIMIT	SEEDLING MORT'Y.	WINDTH. HAZARD	PLANT COMPET.	COMMON TREES	SITE INDX	
							NONE		

WINDBREAKS

CLASS-DETERMINING PHASE	SPECIES	HT	SPECIES	HT	SPECIES	HT	SPECIES	HT
	NONE							

WILDLIFE HABITAT SUITABILITY (C)

CLASS-DETERMINING PHASE	POTENTIAL FOR HABITAT ELEMENTS								POTENTIAL AS HABITAT FOR:			
	GRAIN & SEED	GRASS & LEGUME	WILD HERB.	HARDWD TREES	CONIFER PLANTS	SHRUBS	WETLAND PLANTS	SHALLOW WATER	OPENLD WILDLF	WOODLD WILDLF	WETLAND WILDLF	RANGELD WILDLF
ALL	FAIR	GOOD	GOOD	GOOD	-	FAIR	FAIR	FAIR	GOOD	-	FAIR	FAIR

POTENTIAL NATIVE PLANT COMMUNITY (RANGELAND OR FOREST UNDERSTORY VEGETATION) (D)

COMMON PLANT NAME	PLANT SYMBOL (NLSPN)	PERCENTAGE COMPOSITION (DRY WEIGHT) BY CLASS DETERMINING PHASE				
		ALL				
LITTLE BLUESTEM	ANSC2	30				
BIG BLUESTEM	ANGE	15				
INDIANGRASS	SONU2	15				
VIRGINIA WILDRYE	ELVI3	5				
OTHER PERENNIAL FORBS	PPPP	5				
OTHER TREES	TTTT	5				
TEXAS NEEDLEGRASS	STLE5	5				
TURKEY SILVER BLUESTEM	ANSA7	5				
MEADOW DROPSEED	SPAS	5				
SWITCHGRASS	PAVI2	10				
POTENTIAL PRODUCTION (LBS./AC. DRY WT):						
FAVORABLE YEARS		6000				
NORMAL YEARS		5000				
UNFAVORABLE YEARS		3000				

FOOTNOTES

A EST BASED ON ENG TEST DATA OF 5 PEDONS FROM GUADALUPE, TRAVIS AND CALDWELL COS. TEXAS; LINE 1 INCLUDES CL-ML, SM-SC.
B RATINGS BASED ON NATIONAL SOILS HANDBOOK, SEC. 403.
C WILDLIFE RATINGS BASED ON SOILS MEMORANDUM-74, JAN. 1972.
D CLAYPAN PRAIRIE SITE.

Established Series
Rev. GLL:CLG
1/81

PADINA SERIES

The Padina series consists of deep, moderately well drained, moderately slowly permeable soils formed in thick sandy materials. These soils are on uplands and high terraces. Slopes range from 0 to 15 percent. Mean annual precipitation is about 38 inches and mean annual temperature is about 68° F.

Taxonomic Class: Loamy, siliceous, thermic Grossarenic Paleustalfs.

Typical Pedon: Padina fine sand--wooded pasture.
(Colors are for dry soil unless otherwise stated.)

A1--0 to 8 inches; pale brown (10YR 6/3) fine sand, brown (10YR 5/3) moist; single grained; loose; common fine, medium and coarse roots; medium acid; clear smooth boundary. (4 to 22 inches thick)

A2--8 to 49 inches; very pale brown (10YR 7/4) fine sand, light yellowish brown (10YR 6/4) moist; single grained; loose; few fine and medium roots; medium acid; clear wavy boundary. (35 to 72 inches thick)

B21t--49 to 65 inches; very pale brown (10YR 7/3) sandy clay loam, pale brown (10YR 6/3) moist; common coarse distinct reddish yellow (5YR 6/6) mottles and few fine distinct strong brown and light gray mottles; weak coarse blocky structure; very hard, very firm; few fine roots; few fine pores; thin patchy clay films; strongly acid; gradual smooth boundary. (8 to 29 inches thick)

B22t--65 to 82 inches; white (10YR 8/2) sandy clay loam, light gray (10YR 7/2) moist; many coarse prominent red (2.5YR 4/6), and common medium prominent reddish yellow (7.5YR 5/6) mottles; weak coarse blocky structure; hard, firm; few fine roots; few fine pores; few thin patchy clay films; strongly acid.

Type Location: Falls County, Texas; from Bremond, Texas; 4.6 miles north on Texas Highway 14; then southeast on a county road 0.6 mile, and 100 feet north of county road in a wooded pasture.

Range in Characteristics: Solum thickness ranges from 65 to more than 100 inches.

The A1 horizon is dark grayish brown to pale brown or yellowish brown in a hue of 10YR, with values of 4 through 7 and chromas of 2 through 4.

The A2 horizon is brown to white or light yellowish brown in hues of 7.5YR to 10YR, with values of 5 through 8 and chromas of 2 through 6. The boundary between the A2 and Bt horizon is wavy to irregular

The A horizon is medium acid through neutral loamy fine sand or fine sand. It is 40 to 80 inches thick.

The Bt horizon is light gray or white to reddish yellow or yellowish red in hues of 5YR through 10YR, with values of 5 through 8 and chromas of 1 through 8 with varying amount of reddish, yellowish, brownish, and grayish mottles. It is dominantly sandy clay loam but ranges from fine sandy loam to clay loam with a clay content of 18 to 35 percent. Albic material and skeletans of clean sand comprise up to 15 percent by volume in some pedons. It is slightly acid through strongly acid. Base saturation is 40 to 75 percent.

Competing Series: These include the Catilla, Desan, and Patilo series in the same family. Similar soils include the Arenosa, Eufaula, Nimrod, and Stidham series. Catilla soils contain more than 5 percent plinthite in the Bt horizon. Desan soils lack mottles with chromas of 2 or less in the Bt horizon that are due to wetness. Patilo soils are dry in the moisture control section for longer periods. Arenosa soils lack Bt horizons. Eufaula soils have Bt horizons in lamellae. Nimrod and Stidham soils have A horizons less than 40 inches thick.

Geographic Setting: Padina soils are on uplands and high terraces. Slopes are 0 to 15 percent, with concave and convex surfaces. The soil formed in thick sandy beds that appear to have been reworked somewhat by wind. The mean annual temperature is 66° to 70° F.; average annual precipitation is 35 to 42 inches; Thornthwaite annual P-E indices are 54 to 64.

Geographically Associated Soils: These are the competing Arenosa and Eufaula series, and the Silstid series. Silstid soils have sandy surface layers 20 to 40 inches thick.

Drainage and Permeability: Moderately well drained; slow runoff; moderately slow permeability. Perched water tables occur for short periods following heavy rainfalls.

Use and Vegetation: Mainly brushy rangeland and used for grazing. A few areas are cultivated to peanuts and watermelons. Native vegetation is a scrub forest of post oak, blackjack oak, bluejack oak, and scattered hickory, with an understory of greenbrier, sassafras, American beautyberry, yaupon, little bluestem, purpletop, sand lovegrass, low paspalums, low panicums, and splitbeard bluestem.

Distribution and Extent: Mainly in the sandy timbered areas of Texas that are east and south of the Blackland Prairies. The series is of moderate extent.

Series Established: Falls County, Texas; 1976.

Remarks: These soils were formerly included in the Patilo series and classified in the Red-Yellow Podzolic great soil group.

National Cooperative Soil Survey
U. S. A.

PADINA SERIES

TX0551

RECREATIONAL DEVELOPMENT (B)

CAMP AREAS	0-6% LFS: SLIGHT 6-15% LFS: MODERATE-SLOPE FS: SEVERE-TOO SANDY	PLAYGROUNDS	0-2% LFS: SLIGHT 2-6% LFS: MODERATE-SLOPE 6+% LFS: SEVERE-SLOPE 0-6% FS: SEVERE-TOO SANDY 6+% FS: SEVERE-SLOPE,TOO SANDY
PICNIC AREAS	0-6% LFS: SLIGHT 6-15% LFS: MODERATE-SLOPE FS: SEVERE-TOO SANDY	PATHS AND TRAILS	LFS: SLIGHT FS: SEVERE-TOO SANDY

CAPABILITY AND YIELDS PER ACRE OF CROPS AND PASTURE (HIGH LEVEL MANAGEMENT)

CLASS-DETERMINING PHASE	CAPABILITY		PEANUTS (LBS)		IMPROVED BERMUDAGR. (AUM)											
	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.
0-6% FS.LFS	3S		1000		5.0											
9-6% FS.LFS	4E		800		4.5											
6-15% FS.LFS	4E		-		4.0											

WOODLAND SUITABILITY

CLASS-DETERMINING PHASE	ORD SYM	MANAGEMENT PROBLEMS: EROSION HAZARD	EQUIP. LIMIT	SEEDLING MORT'Y.	WINDTH. HAZARD	PLANT COMPET.	POTENTIAL PRODUCTIVITY: COMMON TREES	SITE INDX	TREES TO PLANT
							NONE		

WINDBREAKS

CLASS-DETERMINING PHASE	SPECIES	HT	SPECIES	HT	SPECIES	HT	SPECIES	HT
	NONE							

WILDLIFE HABITAT SUITABILITY (C)

CLASS-DETERMINING PHASE	POTENTIAL FOR HABITAT ELEMENTS: GRAIN & SEED	GRASS & LEGUME	WILD HERB.	HARDWD TREES	CONIFER PLANTS	SHRUBS	WETLAND PLANTS	SHALLOW WATER	POTENTIAL AS HABITAT FOR: OPENLD WILDLF	WOODLD WILDLF	WETLAND WILDLF	RANGELD WILDLF
0-6% FS.LFS	FAIR	GOOD	FAIR	-	-	FAIR	POOR	V. POOR	FAIR	-	V. POOR	FAIR
6-15% FS.LFS	POOR	FAIR	FAIR	-	-	FAIR	V. POOR	V. POOR	FAIR	-	V. POOR	FAIR

POTENTIAL NATIVE PLANT COMMUNITY (RANGELAND OR FOREST UNDERSTORY VEGETATION) (D)

COMMON PLANT NAME	PLANT SYMBOL (NLSPN)	PERCENTAGE COMPOSITION (DRY WEIGHT) BY CLASS DETERMINING PHASE: ALL				
LITTLE BLUESTEM	ANSC2	20				
PURPLETOP	TRFL2	15				
SAND LOVEGRASS	ERTR3	5				
INDIANGRASS	SONU2	5				
TALL DROPSEED	SPAS	5				
PANICUM	PANIC	10				
PASPALUM	PASPA2	10				
LONGLEAF UNIOLA	UNSE	5				
SPLITBEARD BLUESTEM	ANTE2	6				
BLUEJACK OAK	QUIN	5				
POST OAK	QUST	5				
BLACKJACK OAK	QUMA3	5				
OTHER TREES	TTTT	3				
OTHER PERENNIAL FORBS	PPPP	5				
POTENTIAL PRODUCTION (LBS./AC. DRY WT): FAVORABLE YEARS		4500				
NORMAL YEARS		3000				
UNFAVORABLE YEARS		2250				

FOOTNOTES

A ESTIMATES BASED ON ENGINEERING TEST DATA OF SIMILAR SOILS.
B RATINGS BASED ON NATIONAL SOILS HANDBOOK, SEC. 403.
C WILDLIFE RATINGS BASED ON SOILS MEMORANDUM-74, JAN. 1972.
D DEEP SAND RANGE SITE.

Established Series
Rev. WGC:LCP
11/78

SHALBA SERIES

The Shalba series consists of shallow, somewhat poorly drained, very slowly permeable soils that formed in tuffaceous fine grained sandstone. These soils are on gently sloping to sloping convex uplands. Water runs off the surface at a medium rate. Slope is dominantly 1 to 5 percent but ranges from 1 to 8 percent.

Taxonomic Class: Clayey, montmorillonitic, thermic, shallow Typic Albaqualfs.

Typical Pedon: Shalba fine sandy loam on a convex 2 percent slope in open field. (Colors are for moist soil unless otherwise stated.)

A1--0 to 4 inches; grayish brown (10YR 5/2) fine sandy loam, light gray (10YR 7/2) dry; massive; hard, friable; many fine roots; common fine and medium pores; very strongly acid; abrupt wavy boundary. (3 to 8 inches thick)

B2t--4 to 18 inches; dark grayish brown (10YR 4/2) clay, grayish brown (10YR 5/2) dry; few fine distinct yellowish brown (10YR 5/4) mottles; weak medium angular blocky structure; very hard, very firm, very sticky and very plastic; common clay films; patchy dark coatings on faces of peds; few wormcasts; few fine roots; few fine and medium pores; very strongly acid; clear wavy boundary. (6 to 17 inches thick)

Cr--18 to 40 inches; light gray (10YR 7/2) weakly cemented, tuffaceous sandstone; few fine roots along fractures; strongly acid.

Type Location: Washington County, Texas; from the intersection of Texas 36 and Farm Road 1948 near Lake Somerville, 0.1 mile west on Farm Road 1948, 0.6 mile north on Overlook Road, 0.9 mile west on paved and gravel road to ridgetop, site is 50 feet north of road in open field.

Range in Characteristics: Solum thickness and depth to paralithic contact ranges from 14 to 20 inches.

The A horizon has hue of 10YR, value of 5 through 7, and chroma of 1 or 2. Texture of the A horizon is fine sandy loam. The reaction ranges from medium acid through very strongly acid. The boundary between the A and Bt horizons is abrupt and wavy.

The Bt horizon has hue of 10YR, value of 3 through 5, and chroma of 1 or 2. Ped coatings of very dark gray, dark gray, and very dark grayish brown range from few to common. Mottles are in ped interiors and range from none to common, fine to medium in shades of brown and yellow. Structure ranges from weak to moderate, medium angular blocky. The reaction of the Bt ranges from medium acid through very strongly acid. The lower boundary of the Bt is wavy or irregular.

The Cr horizon is a clayey tuff, tuffaceous sandstone, siltstone, or tuffaceous clay. Texture ranges from sandy loam to clay loam. Reaction ranges from strongly acid through mildly alkaline.

Competing Series: There are no other series in the family. Similar soils are the Arol, Burlewash, Corrigan, and Falba. All of these have a solum thickness greater than 20 inches. In addition, Arol soils are less acid in the Bt horizon. Burlewash soils lack aquic moisture regimes, and Corrigan soils are in areas of higher rainfall.

Geographic Setting: Shalba soils are on nearly level to sloping convex uplands. Slopes are mainly 1 to 5 percent but range from 1 to 8 percent. These soils developed from interbedded clays, tuffs, ash beds, sandstones, and siltstones of the Catahoula and related formations.

Geographically Associated Soils: These are the similar Arol, Burlewash, and Falba series. Arol and Falba are on similar positions with Shalba. Burlewash soils are on slightly higher more sloping landscape.

Drainage and Permeability: Shalba soils are somewhat poorly drained. Runoff is medium. Permeability is very slow. The soil has a perched water table during the winter and spring of most years.

Use and Vegetation: Used for improved pastures or ranges. Native vegetation is scattered post oak, blackjack oak, cedar, and yaupon with little bluestem, indiangrass, purple top and other grasses.

Distribution and Extent: Mainly in east and south-central Texas. This soil is inextensive.

Series Established: Washington County, Texas; 1978.

Remarks: These soils were formerly mapped as shallow phases of the Lufkin or Falba series.

National Cooperative Soil Survey
U. S. A.

TX0088

SOIL INTERPRETATIONS RECORD

MLRA(S): 87
REV. WGC-LCB, 3-75
TYPIC ALBAQUALFS, CLAYEY, MONTMORILLONITIC, THERMIC, SHALLOW

SHALBA SERIES

THE SHALBA SERIES CONSISTS OF SHALLOW, SOMEWHAT POORLY DRAINED, NEARLY LEVEL TO SLOPING SOILS OF UPLANDS THE SOIL FORMED IN TUFFACEOUS MATERIALS. IN A REPRESENTATIVE PROFILE, THE SURFACE LAYER IS LIGHT GRAY FINE SANDY LOAM, ABOUT 4 INCHES THICK. THE SUBSOIL, FROM 4 TO 18 INCHES, IS GRAYISH BROWN CLAY. BELOW THIS IS WEAKLY CEMENTED TUFFACEOUS SANDSTONE. SLOPES RANGE FROM 0 TO 8 PERCENT.

ESTIMATED SOIL PROPERTIES (A)

DEPTH (IN.)	USDA TEXTURE	UNIFIED	AASHTO	FRACT >3 IN (PCT)	PERCENT OF MATERIAL LESS THAN 3" PASSING SIEVE NO. 4	10	40	200	LIQUID LIMIT	PLASTICITY INDEX
0-4	FSL	SM-SC, SM, CL-ML, ML	A-4	0	95-100	95-100	70-98	40-60	<20	NP-7
4-18	C	CH	A-7	0	95-100	95-100	90-100	75-95	51-70	34-48
18-40	WB									

DEPTH (IN.)	CLAY (PCT <2MM)	MOIST BULK DENSITY (G/CM3)	PERMEABILITY (IN/HR)	AVAILABLE WATER CAPACITY (IN/IN)	SOIL REACTION (PH)	SALINITY (MMHOS/CM)	SHRINK-SWELL POTENTIAL	EROSION FACTORS K	T	WIND EROD. GROUP	ORGANIC MATTER (PCT)	CORROSIVITY STEEL	CONCRETE
0-4	5-15		0.6-2.0	0.11-0.15	4.5-6.5	-	LOW	.43	1	-	<1	HIGH	MODERATE
4-18	40-60		<0.06	0.14-0.18	4.5-6.0	-	HIGH	.32					
18-40													

FLOODING FREQUENCY	DURATION	MONTHS	HIGH WATER TABLE DEPTH (FT)	KIND	MONTHS	CEMENTED PAN DEPTH (IN)	HARDNESS	BEDROCK DEPTH (IN)	HARDNESS	SUBSIDENCE INIT. (IN)	TOTAL (IN)	HYD GRP	POTENT'L FROST ACTION
NONE			0-1.5	PERCHED	OCT-MAY	-		7-20	SOFT	-		D	-

SANITARY FACILITIES (B)

SEPTIC TANK ABSORPTION FIELDS	SEVERE-DEPTH TO ROCK,WETNESS,PERCS SLOWLY
SEWAGE LAGOON AREAS	0-7%: SEVERE-DEPTH TO ROCK 7+%: SEVERE-DEPTH TO ROCK,SLOPE
SANITARY LANDFILL (TRENCH)	SEVERE-DEPTH TO ROCK,WETNESS
SANITARY LANDFILL (AREA)	SEVERE-WETNESS,DEPTH TO ROCK
DAILY COVER FOR LANDFILL	POOR-AREA RECLAIM,WETNESS,TOO CLAYEY

CONSTRUCTION MATERIAL (B)

ROADFILL	POOR-LOW STRENGTH,THIN LAYER,WETNESS
SAND	IMPROBABLE-EXCESS FINES
GRAVEL	IMPROBABLE-EXCESS FINES
TOPSOIL	POOR-THIN LAYER,AREA RECLAIM,WETNESS

BUILDING SITE DEVELOPMENT (B)

SHALLOW EXCAVATIONS	SEVERE-WETNESS,DEPTH TO ROCK
DWELLINGS WITHOUT BASEMENTS	SEVERE-WETNESS,SHRINK-SWELL
DWELLINGS WITH BASEMENTS	SEVERE-WETNESS,DEPTH TO ROCK,SHRINK-SWELL
SMALL COMMERCIAL BUILDINGS	SEVERE-WETNESS,SHRINK-SWELL
LOCAL ROADS AND STREETS	SEVERE-LOW STRENGTH,WETNESS,SHRINK-SWELL
LAWNS, LANDSCAPING AND GOLF FAIRWAYS	SEVERE-WETNESS,THIN LAYER

WATER MANAGEMENT (B)

POND RESERVOIR AREA	SEVERE-DEPTH TO ROCK
EMBANKMENTS DIKES AND LEVEES	SEVERE-THIN LAYER,WETNESS,HARD TO PACK
EXCAVATED PONDS AQUIFER FED	SEVERE-NO WATER
DRAINAGE	PERCS SLOWLY,DEPTH TO ROCK
IRRIGATION	PERCS SLOWLY,ERODES EASILY,DEPTH TO ROCK
TERRACES AND DIVERSIONS	PERCS SLOWLY,ERODES EASILY,DEPTH TO ROCK
GRASSED WATERWAYS	PERCS SLOWLY,WETNESS,ERODES EASILY

REGIONAL INTERPRETATIONS

SHALBA SERIES

TX0080

RECREATIONAL DEVELOPMENT (B)

CAMP AREAS	SEVERE-WETNESS,DEPTH TO ROCK,PERCS SLOWLY	PLAYGROUNDS	0-6%: SEVERE-WETNESS,PERCS SLOWLY, DEPTH TO ROCK 6+%: SEVERE-SLOPE,WETNESS,DEPTH TO ROCK
PICNIC AREAS	SEVERE-WETNESS,PERCS SLOWLY,DEPTH TO ROCK	PATHS AND TRAILS	SEVERE-WETNESS,ERODES EASILY

CAPABILITY AND YIELDS PER ACRE OF CROPS AND PASTURE (HIGH LEVEL MANAGEMENT)

CLASS-DETERMINING PHASE	CAPABILITY		COMMON BERMUDAGRASS (AUM)		IMPROVED BERMUDAGR. (AUM)											
	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.
0-2%	4S		3.0		4.0											
2-6%	4E		3.0		4.0											

WOODLAND SUITABILITY

CLASS-DETERMINING PHASE	ORD SYM	MANAGEMENT PROBLEMS					POTENTIAL PRODUCTIVITY		TREES TO PLANT
		EROSION HAZARD	EQUIP. LIMIT	SEEDLING MORT'Y.	WINDTH. HAZARD	PLANT COMPET.	COMMON TREES	SITE INDX	
							NONE		

WINDBREAKS

CLASS-DETERMINING PHASE	SPECIES	HT	SPECIES	HT	SPECIES	HT	SPECIES	HT
	NONE							

WILDLIFE HABITAT SUITABILITY (C)

CLASS-DETERMINING PHASE	POTENTIAL FOR HABITAT ELEMENTS								POTENTIAL AS HABITAT FOR:			
	GRAIN & SEED	GRASS & LEGUME	WILD HERB.	HARDWD TREES	CONIFER PLANTS	SHRUBS	WETLAND PLANTS	SHALLOW WATER	OPENLD WILDLF	WOODLD WILDLF	WETLAND WILDLF	RANGELD WILDLF
ALL	POOR	POOR	POOR	-	-	FAIR	POOR	V. POOR	POOR	-	V. POOR	POOR

POTENTIAL NATIVE PLANT COMMUNITY (RANGELAND OR FOREST UNDERSTORY VEGETATION) (D)

COMMON PLANT NAME	PLANT SYMBOL (NLSPN)	PERCENTAGE COMPOSITION (DRY WEIGHT) BY CLASS DETERMINING PHASE				
LITTLE BLUESTEM	ANSC2	40				
INDIANGRASS	SONU2	10				
PURPLETOP	TRFL2	10				
BROWNSEED PASPALUM	PAPL3	10				
SWITCHGRASS	PAVI2	5				
POST OAK	QUST	10				
BLACKJACK OAK	QUMA3	5				
OTHER PERENNIAL FORBS	PPFF	5				
OTHER SHRUBS	SSSS	5				
POTENTIAL PRODUCTION (LBS./AC. DRY WT):						
FAVORABLE YEARS		4000				
NORMAL YEARS		3000				
UNFAVORABLE YEARS		2000				

FOOTNOTES

A ESTIMATES BASED ON TEST DATA OF SIMILAR SOILS
B RATINGS BASED ON NATIONAL SOILS HANDBOOK, SEC. 403.
C WILDLIFE RATINGS BASED ON SOILS MEMORANDUM-74, JAN. 1972.
D CLAYPAN SAVANNAH RANGE SITE.

Established Series
Rev. RHB:LCB
11/79

TREMONA SERIES

The Tremona series consists of deep, somewhat poorly drained, very slowly permeable soils on uplands. They formed in interbedded clayey and loamy materials. Slopes range from 0 to 8 percent.

Taxonomic Class: Clayey, mixed, thermic Aquic Arenic Paleustalfs.

Typical Pedon: Tremona loamy fine sand--rangeland.
(Colors are for dry soil unless otherwise stated.)

A1--0 to 12 inches; pale brown (10YR 6/3) loamy fine sand, brown (10YR 5/3) moist; structureless; loose, very friable; common fine roots; few fine siliceous pebbles; slightly acid, clear smooth boundary. (8 to 16 inches thick)

A2--12 to 28 inches; very pale brown (10YR 7/3) loamy fine sand, pale brown (10YR 6/3) moist; common medium distinct light yellowish brown (10YR 6/4) mottles in the lower part; structureless; loose, very friable; few fine roots; common fine siliceous pebbles in the upper part that increases to 30 percent by volume in the lower 2 inches, slightly acid; abrupt wavy boundary. (10 to 24 inches thick)

B21t--28 to 40 inches; gray (10YR 6/1) sandy clay, gray (10YR 5/1) moist; common medium distinct dark yellowish brown (10YR 4/4) and common medium prominent red (2.5YR 4/8) mottles; moderate medium blocky structure; extremely hard, very firm, sticky and plastic; few plinthite masses within the red mottled areas; few fine roots; many clay films; fine siliceous pebbles comprise about 10 percent by volume; strongly acid; gradual wavy boundary. (8 to 20 inches thick)

B22t--40 to 58 inches; light gray (10YR 7/1) sandy clay, gray (10YR 6/1) moist; common coarse distinct yellowish brown (10YR 5/8) and few fine prominent yellowish red (5YR 5/8) mottles; weak medium blocky structure; extremely hard, very firm, sticky and plastic; few plinthite masses within the red mottled areas; many clay films; fine and medium siliceous pebbles comprise about 5 percent by volume; medium acid; gradual wavy boundary. (8 to 20 inches thick)

B3--58 to 68 inches; white (10YR 8/2) sandy clay loam, light gray (10YR 7/2) moist; common coarse distinct yellowish brown (10YR 5/8) and few fine prominent yellowish red (5YR 5/8) mottles; weak coarse blocky structure; extremely hard, firm, slightly sticky; few fine concretions of calcium carbonate; mildly alkaline; diffuse wavy boundary. (6 to 20 inches thick)

C--68 to 84 inches; white (10YR 8/2) sandy clay loam; common fine distinct strong brown (7.5YR 5/6) mottles; structureless; very hard, friable; few soft masses and few fine concretions of calcium carbonate moderately alkaline.

Type Location: Dewitt County, Texas; from the intersection of U.S. Highway 77A and U.S. Highway 87 in Cuero, Texas; 4.4 miles southeast on U.S. Highway 87; then 3.5 miles northeast on a county road and 50 feet north of road right-of-way in rangeland.

Range in Characteristics: Solum thickness ranges from 50 to more than 80 inches. Coarse fragments, mainly siliceous pebbles, less than three inches in diameter range up to 75 percent by values of the A horizon and less than 15 percent of lower layers.

The A horizon is 20 to 40 inches thick. It has hue of 7.5YR and 10YR, value of 5 to 7 and chroma of 2 to 4. The A2 horizon is one or two units of value greater than the A1. It is fine sand, loamy sand, loamy fine sand or their gravelly counterparts. Reaction ranges from strongly acid to slightly acid.

The B2t horizon is typically grayish and has hue of 10YR and 2.5Y, value of 5 to 7, chroma of 1 or 2. Yellowish, reddish, and brownish mottles range from few to a mottled matrix of these colors. Texture is clay, sandy clay, clay loam, or sandy clay loam with clay content of the control section ranging from 35 to 50 percent. The reaction ranges from very strongly acid through medium acid. Plinthite ranges from none to about 4 percent by volume.

The B3 and C horizons are in shades of gray, brown, yellow and white and are usually sandy clay loam or clay loam but sandy and clayey layers are in some pedons. The reaction ranges from strongly acid through moderately alkaline. The C horizon is very strongly acid in some pedons. Concretions, threads, films, or soft masses of calcium carbonate range from none to common.

Competing Series: These are the Demona series in the same family and the Leming, Nimrod, Nueces, Rehburg, and Straber series in similar families. Demona soils have redder upper Bt horizons and have formed in Cretaceous Age materials. Leming soils are slightly acid through mildly alkaline in the B2t horizon and have hyperthermic temperature regimes. Nimrod and Nueces soils have loamy control sections and, in addition, Nueces soils have hyperthermic temperature regimes. Rehburg soils have montmorillonitic mineralogy and have a solum 40 to 60 inches thick over tuffaceous clay beds. Straber soils have A horizons less than 20 inches thick.

Geographic Setting: Tremona soils are on nearly level to gently sloping uplands. Areas are usually slightly concave in shape. Slope gradients range from 0 to 8 percent, but are mainly 1 to 5 percent. The soil formed in interbedded clayey and loamy deposits mainly associated with Citronelle geology. Climate is subhumid. Mean annual temperatures are 68° to 70° F., average annual precipitation is 32 to 42 inches, and Thornthwaite annual P-E index is 44 to 64.

Geographically Associated Soils: These are the competing Straber series and the Catilla, Ellen, Padina, and Silvern series. Catilla and Padina soils are on slightly higher smooth areas and have thicker sandy A horizons. Ellen and Silvern soils have loamy control sections containing more than 35 percent gravel and are on nearby landscapes.

Drainage and Permeability: Somewhat poorly drained; slow to very slow runoff; very slow permeability. A temporary perched water table is often present in and above the B21t horizon following heavy rains.

Use and Vegetation: Mainly brushy rangeland and used for grazing. Some areas are in improved bermudagrass pastures. Native vegetation is post oak, blackjack oak, hickory, and scattered live oak trees, with an understory of yaupon, grapevines, little bluestem, and paspalums.

Distribution and Extent: Mainly in the southern part of the Texas Claypan area of south Texas. The soil is extensive.

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Series Established: Dewitt County, Texas; 1973.

TX0046

S O I L   I N T E R P R E T A T I O N S   R E C O R D

MLRA(S): 87
LCB.DJW. 1-80
AQUIC ARENIC PALEUSTALFS. CLAYEY. MIXED. THERMIC

TREMONA SERIES

THE TREMONA SERIES CONSISTS OF DEEP. SOMEWHAT POORLY DRAINED. VERY SLOWLY PERMEABLE SOILS ON UPLANDS. THEY HAVE PALE BROWN TO VERY PALE BROWN SANDY SURFACE LAYERS 20 TO 40 INCHES THICK. AND GRAY TO LIGHT GRAY SANDY CLAY SUBSOILS THAT GRADE TO WHITE SANDY CLAY LOAM UNDERLYING LAYERS. THE SOIL FORMED IN ACID LOAMY AND CLAYEY DEPOSITS. SLOPE GRADIENTS RANGE FROM 0 TO 8 PERCENT.

ESTIMATED SOIL PROPERTIES (A)

DEPTH (IN.)	USDA TEXTURE	UNIFIED	AASHTO	FRACT >3 IN (PCT)	PERCENT OF MATERIAL LESS THAN 3" PASSING SIEVE NO. 4	10	40	200	LIQUID LIMIT	PLAS-TICITY INDEX
0-28	LFS. FS. LS	SM. SP-SM	A-2-4. A-3	0	80-100	80-100	60-100	8-35	<25	NP-3
0-28	GR-LFS.GRV-LFS.GR-LS	GP-GM. GM. SM. SP-SM	A-1. A-3. A-2-4	0-5	20-80	15-80	10-75	6-20	<25	NP-3
28-58	SC. C	SC. CL. CH	A-7	0	80-100	80-100	75-100	36-85	40-60	20-40
58-80	SCL. SC	SC. CL. CH	A-7.A-6.A-2-7.A-2-6	0	80-100	80-100	70-100	30-85	30-60	15-40

DEPTH (IN.)	CLAY (PCT <2MM)	MOIST BULK DENSITY (G/CM3)	PERMEA-BILITY (IN/HR)	AVAILABLE WATER CAPACITY (IN/IN)	SOIL REACTION (PH)	SALINITY (MMHOS/CM)	SHRINK-SWELL POTENTIAL	EROSION FACTORS K	T	WIND EROD. GROUP	ORGANIC MATTER (PCT)	CORROSIVITY STEEL	CONCRETE
0-28	2-10		6.0-20	0.04-0.10	5.1-6.5	-	VERY LOW	.24	5	2	<1	HIGH	HIGH
0-28	2-10		6.0-20	0.01-0.07	5.1-6.5	-	VERY LOW	.20	5	-	<1		
28-58	35-60		<0.06	0.12-0.18	4.5-6.0	-	HIGH	.28					
58-80	25-45		<0.06	0.12-0.18	4.5-6.4	-	HIGH	.37					

FLOODING FREQUENCY	DURATION	MONTHS	HIGH WATER TABLE DEPTH (FT)	KIND	MONTHS	CEMENTED PAN DEPTH (IN)	HARDNESS	BEDROCK DEPTH (IN)	HARDNESS	SUBSIDENCE INIT. (IN)	TOTAL (IN)	HYD GRP	POTENT'L FROST ACTION
NONE			1.5-3.5	PERCHED	JUN-SEP	-		>60		-		C	-

SANITARY FACILITIES (B)

SEPTIC TANK ABSORPTION FIELDS	SEVERE-WETNESS.PERCS SLOWLY.POOR FILTER
SEWAGE LAGOON AREAS	0-7%: SEVERE-SEEPAGE 7+%: SEVERE-SEEPAGE.SLOPE
SANITARY LANDFILL (TRENCH)	SEVERE-WETNESS.TOO CLAYEY
SANITARY LANDFILL (AREA)	SEVERE-SEEPAGE
DAILY COVER FOR LANDFILL	POOR-TOO CLAYEY.HARD TO PACK

BUILDING SITE DEVELOPMENT (B)

SHALLOW EXCAVATIONS	SEVERE-CUTBANKS CAVE.WETNESS
DWELLINGS WITHOUT BASEMENTS	MODERATE-WETNESS
DWELLINGS WITH BASEMENTS	SEVERE-WETNESS.SHRINK-SWELL
SMALL COMMERCIAL BUILDINGS	0-4%: MODERATE-WETNESS 4-8%: MODERATE-WETNESS.SLOPE
LOCAL ROADS AND STREETS	MODERATE-WETNESS
LAWNS. LANDSCAPING AND GOLF FAIRWAYS	LFS.FS.LS: MODERATE-WETNESS.DROUGHTY GR.GRV: SEVERE-DROUGHTY

REGIONAL INTERPRETATIONS

CONSTRUCTION MATERIAL (B)

ROADFILL	POOR-LOW STRENGTH.SHRINK-SWELL
SAND	IMPROBABLE-EXCESS FINES
GRAVEL	IMPROBABLE-EXCESS FINES
TOPSOIL	LFS: FAIR-TOO SANDY FS: POOR-TOO SANDY GR.GRV: POOR-SMALL STONES

WATER MANAGEMENT

POND RESERVOIR AREA	SLIGHT
EMBANKMENTS DIKES AND LEVEES	MODERATE-HARD TO PACK.WETNESS
EXCAVATED PONDS AQUIFER FED	SEVERE-NO WATER
DRAINAGE	0-3%: PERCS SLOWLY 3+%: PERCS SLOWLY.SLOPE
IRRIGATION	WETNESS.DROUGHTY.FAST INTAKE
TERRACES AND DIVERSIONS	GR.GRV: WETNESS.PERCS SLOWLY LFS.FS.LS: WETNESS.SOIL BLOWING.PERCS SLOWLY
GRASSED WATERWAYS	DROUGHTY.PERCS SLOWLY

TREMONA SERIES

TX0046

RECREATIONAL DEVELOPMENT (B)

CAMP AREAS	LFS.LS: MODERATE-WETNESS,PERCS SLOWLY GR.GRV: SEVERE-SMALL STONES FS: SEVERE-TOO SANDY	PLAYGROUNDS	0-2% LFS.FS.LS: MODERATE-SMALL STONES 2-6% LFS.FS.LS: MODERATE-SLOPE,SMALL STONES 6+% LFS.FS.LS: SEVERE-SLOPE 0-6% GR.GRV: SEVERE-SMALL STONES 6+% GR.GRV: SEVERE-SLOPE,SMALL STONES
PICNIC AREAS	LFS.LS.GR.GRV: MODERATE-WETNESS,PERCS SLOWLY FS: SEVERE-TOO SANDY	PATHS AND TRAILS	GR.GRV: MODERATE-WETNESS FS: SEVERE-TOO SANDY

CAPABILITY AND YIELDS PER ACRE OF CROPS AND PASTURE (HIGH LEVEL MANAGEMENT)

CLASS-DETERMINING PHASE	CAPA-BILITY		GRAIN SORGHUM (BU)		PEANUTS (LBS)		IMPROVED BERMUDAGR. (AUM)									
	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.
0-5% LFS.FS.LS	3E		45		1200		5.5									
0-5% GR.GRV	4S		35		-		5.0									
5-8%	4E		30		900		4.5									

WOODLAND SUITABILITY

CLASS-DETERMINING PHASE	ORD SYM	MANAGEMENT PROBLEMS: EROSION HAZARD	EQUIP. LIMIT	SEEDLING MORT'Y.	WINDTH. HAZARD	PLANT COMPET.	POTENTIAL PRODUCTIVITY: COMMON TREES	SITE INDX	TREES TO PLANT
							NONE		

WINDBREAKS

CLASS-DETERMINING PHASE	SPECIES	HT	SPECIES	HT	SPECIES	HT	SPECIES	HT
	NONE							

WILDLIFE HABITAT SUITABILITY (C)

CLASS-DETERMINING PHASE	POTENTIAL FOR HABITAT ELEMENTS								POTENTIAL AS HABITAT FOR:			
	GRAIN & SEED	GRASS & LEGUME	WILD HERB.	HARDWD TREES	CONIFER PLANTS	SHRUBS	WETLAND PLANTS	SHALLOW WATER	OPENLD WILDLF	WOODLD WILDLF	WETLAND WILDLF	RANGELD WILDLF
LFS.FS.LS	FAIR	GOOD	GOOD	-	-	GOOD	V. POOR	V. POOR	GOOD	-	V. POOR	GOOD
GR.GRV	POOR	POOR	FAIR	-	-	GOOD	V. POOR	V. POOR	POOR	-	V. POOR	FAIR

POTENTIAL NATIVE PLANT COMMUNITY (RANGELAND OR FOREST UNDERSTORY VEGETATION) (D)

COMMON PLANT NAME	PLANT SYMBOL (NLSPN)	PERCENTAGE COMPOSITION (DRY WEIGHT) BY CLASS DETERMINING PHASE: LFS.FS.LS	GR.GRV			
LITTLE BLUESTEM	ANSC2	40	50			
INDIANGRASS	SONU2	10	5			
SAND LOVEGRASS	ERTR3	5	-			
SWITCHGRASS	PAVI2	5	-			
BROWNSEED PASPALUM	PAPL3	5	5			
PURPLETOP	TRFL2	5	5			
POST OAK	QUST	5	5			
BLACKJACK OAK	QUMA3	5	5			
PANICUM	PANIC	-	5			
OTHER SHRUBS	SSSS	5	5			
OTHER PERENNIAL FORBS	PPFF	5	3			
OTHER ANNUAL FORBS	AAFF	-	2			
OTHER PERENNIAL GRASSES	PPGG	10	10			
POTENTIAL PRODUCTION (LBS./AC. DRY WT): FAVORABLE YEARS		5000	4500			
NORMAL YEARS		3500	3000			
UNFAVORABLE YEARS		2500	2000			

FOOTNOTES

A ESTIMATES BASED ON ENGINEERING TEST DATA OF 1 PEDON FROM DEWITT COUNTY, TEXAS.
B RATINGS BASED ON NATIONAL SOILS HANDBOOK, SEC. 403.
C WILDLIFE RATINGS BASED ON SOILS MEMORANDUM-74, JAN. 1972.
D LFS.FS-SANDY RANGE SITE; GR-LFS, GRV-LFS-GRAVELLY RANGE SITE.

Established Series
Rev. ALN:LCB:CLG
4/81

WILSON SERIES

The Wilson series consists of deep, somewhat poorly drained, very slowly permeable soils that formed in alkaline clayey sediments. These soils are on nearly level to gently sloping ancient terraces or uplands. Slopes are mainly less than 2 percent but range from 0 to 5 percent.

Taxonomic Class: Fine, montmorillonitic, thermic Vertic Ochraqualfs.

Typical Pedon: Wilson silt loam--cropland.
(Colors are for moist soil.)

Ap--0 to 5 inches; very dark gray (10YR 3/1) silt loam, gray (10YR 5/1) dry; weak fine granular structure; massive when dry; very hard, firm; common fine roots; slightly acid; abrupt wavy boundary. (3 to 10 inches thick)

B21tg--5 to 20 inches; very dark gray (10YR 3/1) silty clay, gray (10YR 5/1) dry; moderate medium blocky structure; extremely hard, very firm; few fine roots; few fine pores; thin continuous clay films 1/2 unit of value darker than interior of peds; vertical cracks are filled with material from the Ap horizon; slightly acid; gradual wavy boundary. (10 to 30 inches thick)

B22tg--20 to 32 inches; grayish brown (2.5Y 5/2) silty clay, light brownish gray (2.5Y 6/2) dry; moderate medium blocky structure; extremely hard, very firm; few fine roots; few fine pores; thin continuous clay films on peds; few medium pressure faces; vertical cracks partly filled with material from above; few fine crystals of gypsum; few fine $CaCO_3$ concretions; mildly alkaline; diffuse wavy boundary. (10 to 20 inches thick)

B3g--32 to 65 inches; grayish brown (2.5Y 5/2) silty clay, light brownish gray (2.5Y 6/2) dry; weak coarse blocky structure; extremely hard, very firm; few fine pores; patchy clay films on peds; common fine crystals of gypsum; few fine soft bodies of $CaCO_3$; mildly alkaline; gradual smooth boundary. (15 to 35 inches thick)

C--65 to 77 inches; olive gray (5Y 5/2) silty clay, light gray (5Y 7/2) dry; massive; extremely hard, very firm; few coarse soft bodies of $CaCO_3$; few small fragments of shale; calcareous, moderately alkaline.

Type Location: Kaufman County, Texas; 4 miles southeast of the intersection of Texas Highway 34 and U.S. Highway 175 in Kaufman, 0.15 mile northeast and 0.2 mile southeast of intersection of county road and U.S. Highway 175, 150 feet southwest in field.

Range in Characteristics: Solum thickness ranges from 40 to more than 60 inches. Cracks 0.4 to more than 0.8 inch wide extend from the top of the Bt horizon to depths of 24 inches or more. The abrupt wavy boundary between the A and B horizon gives a series of crests and troughs to the surface of the B horizon.

The A horizon is less than 10 inches thick in more than 50 percent of the pedon, but it is as much as 15 inches thick in subsoil troughs. It is very dark gray (10YR 3/1; N 3/0), dark gray (10YR 4/1; N 4/0), very dark grayish brown (10YR 3/2; 2.5Y 3/2), dark grayish brown (10YR 4/2; 2.5Y 4/2), grayish brown (10YR 5/2), gray (10YR 5/1), or black (10YR 2/1; N 2/0). It is silty clay loam, loam, clay loam, silt loam, gravelly clay loam, or gravelly loam. Coarse fragments of quartz, pebbles, and cobbles comprise 0 to 35 percent by volume. The A horizon is massive and hard to very hard when dry, but is weak granular when moist. In some pedons a light gray A2 horizon less than 1 inch thick occurs above the deeper B horizon troughs, but it is lacking on the B horizon crests. The A horizon ranges from medium acid to neutral.

The B21tg horizon is very dark gray (10YR 3/1; N 3/0), dark gray (10YR 4/1; N 4/0), or black (10YR 2/1; N 2/0). Some pedons contain few to common fine and medium brownish or yellowish mottles. The B21tg horizon is silty clay, clay, silty clay loam, or clay loam and contains 35 to 50 percent clay. Pebbles of quartz and cobbles comprise 0 to 15 percent by volume. The B2tg horizons range from medium acid through moderately alkaline.

The B22tg and B3g horizons are dark gray (10YR 4/1; 5Y 4/1; N 4/0), dark grayish brown (10YR 4/2; 2.5Y 4/2), gray (10YR 5/1, 6/1; 5Y 5/1, 6/1; N 5/0, N 6/0), grayish brown (10YR 5/2; 2.5Y 5/2), light brownish gray (10YR 6/2; 2.5Y 6/2), olive gray (5Y 4/2, 5/2), or light olive gray (5Y 6/2). Some pedons contain mottles of olive, brown, or yellow and the amounts increase with depth. Crystals of gypsum and $CaCO_3$ concretions are lacking in some pedons. The B3g and C horizons range from neutral through moderately alkaline.

The C horizon is gray (10YR 5/1, 6/1), light brownish gray (10YR 6/2; 2.5Y 6/2), pale brown (10YR 6/3), light yellowish brown (10YR 6/4; 2.5Y 6/4), grayish brown (10YR 5/2; 2.5Y 5/2), olive gray (5Y 4/2, 5/2), light olive gray (5Y 6/2), light olive brown (2.5Y 5/4), yellowish brown (10YR 5/4), very pale brown (10YR 7/4, 8/4, 7/3), reddish yellow (7.5YR 6/6), yellowish red (5YR 5/6), or brown (10YR 5/3). Mottles of two or more of these colors occur in some pedons. It is silty clay, clay or shaly clay.

Competing Series: These are the Anacoco, Baldwin, Edna, Lufkin, Mabank, Mayhew, Midland, Panola, Sessum, and Tensas series. Anacoco, Baldwin, Mayhew, Midland, Sessum, and Tensas soils occur in areas of more than 45 inches rainfall and are moist in the moisture control section for longer periods. Edna, Lufkin, and Mabank soils have an abrupt textural change between the A and Bt horizons. Panola soils have dominant chromas of more than 1 in the Bt horizon to depths of 30 inches.

Geographic Setting: Wilson soils are on nearly level to gently sloping uplands or terraces. Slope gradients are 0 to 5 percent but dominantly less than 2 percent. The soil formed in alkaline clayey old alluvium or nearly impervious marine clay. Mean annual temperature ranges from about 64° to 70° F., mean annual precipitation from 32 to 45 inches, and Thornthwaite P-E indices from 50 to 70.

Geographically Associated Soils: These are the competing Mabank series and the Bonham, Burleson, Crockett, Houston Black, and Normangee series. Bonham soils have mollic epipedons. Burleson and Houston Black soils have intersecting slickensides. Crockett and Normangee soils have chromas of more than 2 in the Bt horizon.

Drainage and Permeability: Somewhat poorly drained; very slow to medium surface runoff; very slow internal drainage; very slow permeability.

Use and Vegetation: Wilson soils are cropped to cotton, sorghums, small grain, and corn. Many areas are now idle or are used for unimproved pasture. Original vegetation was tall prairie grasses, mainly andropogon species, and widely spaced mesquite, elm, and oak trees.

Distribution and Extent: Mainly in the Blackland Prairies of Texas, but small areas are in Oklahoma. The soil is extensive, probably exceeding 1,000,000 acres.

Series Established: Wilson County, Texas; 1907.

Remarks: Wilson soils were formerly classified in the Planosol great soil group.

Additional Data: Typical pedon LSL 17788-17793 and LSL 17794-17799 - Kaufman County, Texas.

National Cooperative Soil Survey
U. S. A.

TX0298

SOIL INTERPRETATIONS RECORD

MLRA(S): 86
REV. CLG,LCP, 10-81
VERTIC OCHRAQUALFS, FINE, MONTMORILLONITIC, THERMIC

WILSON SERIES

HE WILSON SERIES CONSISTS OF DEEP, SOMEWHAT POORLY DRAINED, NEARLY LEVEL TO GENTLY SLOPING SOILS OF UPLANDS AND ERRACES. THE SOIL FORMED IN ALKALINE CLAYEY ALLUVIUM OR MARINE CLAYS. IN A REPRESENTATIVE PROFILE, THE SURFACE LAYER IS ERY DARK GRAY SILT LOAM ABOUT 5 INCHES THICK. THE SUBSOIL IS SILTY CLAY AND VERY DARK GRAY IN THE UPPER PART AND GRAYISH BROWN IN THE LOWER PART. BELOW 65 INCHES THE SOIL IS OLIVE GRAY SILTY CLAY. SLOPES RANGE FROM 0 TO 5 PERCENT.

ESTIMATED SOIL PROPERTIES (A)

DEPTH (IN.)	USDA TEXTURE	UNIFIED	AASHTO	FRACT >3 IN (PCT)	PERCENT OF MATERIAL LESS THAN 3" PASSING SIEVE NO. 4	10	40	200	LIQUID LIMIT	PLASTICITY INDEX
0-5	SIL, L	CL	A-4, A-6	0	95-100	85-100	80-100	60-96	26-38	10-20
0-5	CL, SICL	CL	A-6, A-7-6	0	95-100	85-100	80-100	60-96	38-49	20-30
0-5	GR-CL, GR-L	CL, SC, GC	A-4, A-6, A-7-6	0-5	50-90	45-85	45-81	45-70	25-56	8-30
5-32	SIC, C, CL	CL, CH	A-7-6	0	90-100	80-100	90-100	65-96	43-56	26-37
32-77	SIC, C, SICL	CL, CH	A-7-6, A-6	0	95-100	90-100	85-100	70-96	38-65	24-48

DEPTH (IN.)	CLAY (PCT)	MOIST BULK DENSITY (G/CM3)	PERMEABILITY (IN/HR)	AVAILABLE WATER CAPACITY (IN/IN)	SOIL REACTION (PH)	SALINITY (MMHOS/CM)	SHRINK-SWELL POTENTIAL	EROSION FACTORS K	T	WIND EROD. GROUP	ORGANIC MATTER (PCT)	CORROSIVITY STEEL	CONCRETE
0-5	18-27	1.40-1.65	0.2-0.6	0.15-0.20	5.6-7.3	-	LOW	.43	5	-	.5-2	HIGH	HIGH
0-5	27-40	1.40-1.65	0.2-0.6	0.15-0.20	5.6-7.3	-	LOW	.43	5	-	.5-2		
0-5	25-40	1.40-1.65	0.2-0.6	0.10-0.15	5.6-7.3	-	LOW	.28	5	-	.5-2		
5-32	35-50	1.50-1.70	<0.06	0.14-0.20	5.6-8.4	-	HIGH	.37					
32-77	35-60	1.50-1.70	<0.06	0.12-0.15	6.6-8.4	-	HIGH	.37					

FLOODING FREQUENCY	DURATION	MONTHS	HIGH WATER TABLE DEPTH (FT)	KIND	MONTHS	CEMENTED PAN DEPTH (IN)	HARDNESS	BEDROCK DEPTH (IN)	HARDNESS	SUBSIDENCE INIT. (IN)	TOTAL (IN)	HYD GRP	POTENT'L FROST ACTION
NONE			0-1.0	PERCHED	NOV-MAR	-		>60		-		D	-

SANITARY FACILITIES (B)

SEPTIC TANK ABSORPTION FIELDS	SEVERE-WETNESS,PERCS SLOWLY
SEWAGE LAGOON AREAS	0-2%: SLIGHT 2-5%: MODERATE-SLOPE
SANITARY LANDFILL (TRENCH)	SEVERE-WETNESS,TOO CLAYEY
SANITARY LANDFILL (AREA)	SEVERE-WETNESS
DAILY COVER FOR LANDFILL	POOR-TOO CLAYEY,HARD TO PACK,WETNESS

CONSTRUCTION MATERIAL (B)

ROADFILL	POOR-LOW STRENGTH,WETNESS,SHRINK-SWELL
SAND	IMPROBABLE-EXCESS FINES
GRAVEL	IMPROBABLE-EXCESS FINES
TOPSOIL	POOR-TOO CLAYEY,WETNESS

WATER MANAGEMENT (B)

POND RESERVOIR AREA	SLIGHT
EMBANKMENTS DIKES AND LEVEES	SEVERE-HARD TO PACK,WETNESS
EXCAVATED PONDS AQUIFER FED	SEVERE-NO WATER
DRAINAGE	0-3%: PERCS SLOWLY 3+%: PERCS SLOWLY,SLOPE
IRRIGATION	0-3%: WETNESS,PERCS SLOWLY 3+%: WETNESS,PERCS SLOWLY,SLOPE
TERRACES AND DIVERSIONS	ERODES EASILY,WETNESS,PERCS SLOWLY
GRASSED WATERWAYS	WETNESS,ERODES EASILY,PERCS SLOWLY

BUILDING SITE DEVELOPMENT (B)

SHALLOW EXCAVATIONS	SEVERE-WETNESS
DWELLINGS WITHOUT BASEMENTS	SEVERE-WETNESS,SHRINK-SWELL
DWELLINGS WITH BASEMENTS	SEVERE-WETNESS,SHRINK-SWELL
SMALL COMMERCIAL BUILDINGS	SEVERE-WETNESS,SHRINK-SWELL
LOCAL ROADS AND STREETS	SEVERE-LOW STRENGTH,WETNESS,SHRINK-SWELL
LAWNS, LANDSCAPING AND GOLF FAIRWAYS	SIL,L,CL,SICL: SEVERE-WETNESS GR: SEVERE-SMALL STONES,WETNESS

REGIONAL INTERPRETATIONS

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RECREATIONAL DEVELOPMENT (B)

CAMP AREAS	SIL,L,CL,SICL: SEVERE-WETNESS,PERCS SLOWLY GR: SEVERE-SMALL STONES,WETNESS,PERCS SLOWLY	PLAYGROUNDS	SIL,L,CL,SICL: SEVERE-WETNESS,PERCS SLOWLY GR: SEVERE-SMALL STONES,WETNESS,PERCS SLOWLY
PICNIC AREAS	SIL,L,CL,SICL: SEVERE-WETNESS,PERCS SLOWLY GR: SEVERE-WETNESS,SMALL STONES,PERCS SLOWLY	PATHS AND TRAILS	SEVERE-WETNESS,ERODES EASILY

CAPABILITY AND YIELDS PER ACRE OF CROPS AND PASTURE (HIGH LEVEL MANAGEMENT)

CLASS-DETERMINING PHASE	CAPABILITY		COTTON LINT (LBS)		CORN (BU)		GRAIN SORGHUM (BU)		IMPROVED BERMUDAGR. (AUM)		WHEAT (BU)					
	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.
0-1%	3W		350		45		55		6.0		30					
1-3%	3E		300		35		45		6.0		30					
3-5%	4E		-		30		40		5.5		-					
3-5% ERODED	4E		-		25		35		5.0		-					

WOODLAND SUITABILITY

CLASS-DETERMINING PHASE	ORD SYM	MANAGEMENT PROBLEMS					POTENTIAL PRODUCTIVITY		TREES TO PLANT
		EROSION HAZARD	EQUIP. LIMIT	SEEDLING MORT'Y.	WINDTH. HAZARD	PLANT COMPET.	COMMON TREES	SITE INDX	
							NONE		

WINDBREAKS

CLASS-DETERMINING PHASE	SPECIES	HT	SPECIES	HT	SPECIES	HT	SPECIES	HT
	NONE							

WILDLIFE HABITAT SUITABILITY (C)

CLASS-DETERMINING PHASE	POTENTIAL FOR HABITAT ELEMENTS								POTENTIAL AS HABITAT FOR:			
	GRAIN & SEED	GRASS & LEGUME	WILD HERB.	HARDWD TREES	CONIFER PLANTS	SHRUBS	WETLAND PLANTS	SHALLOW WATER	OPENLD WILDLF	WOODLD WILDLF	WETLAND WILDLF	RANGELD WILDLF
0-3%	FAIR	FAIR	GOOD	-	-	FAIR	FAIR	FAIR	FAIR	-	FAIR	FAIR
3-5%	FAIR	FAIR	GOOD	-	-	FAIR	POOR	POOR	FAIR	-	POOR	FAIR

POTENTIAL NATIVE PLANT COMMUNITY (RANGELAND OR FOREST UNDERSTORY VEGETATION) (D)

COMMON PLANT NAME	PLANT SYMBOL (NLSPN)	PERCENTAGE COMPOSITION (DRY WEIGHT) BY CLASS DETERMINING PHASE				
		ALL				
LITTLE BLUESTEM	ANSC2	45				
INDIANGRASS	SONU2	10				
BIG BLUESTEM	ANGE	10				
VIRGINIA WILDRYE	ELVI3	5				
VINE-MESQUITE	PAOB	5				
FLORIDA PASPALUM	PAFL4	5				
SIDEOATS GRAMA	BOCU	5				
TEXAS WINTERGRASS	STLE5	5				
SILVER BLUESTEM	ANSA	5				
OTHER PERENNIAL FORBS	PPFF	5				
POTENTIAL PRODUCTION (LBS./AC. DRY WT):						
FAVORABLE YEARS		6000				
NORMAL YEARS		4500				
UNFAVORABLE YEARS		3000				

FOOTNOTES

A EST. BASED ON ENGR. TEST DATA OF 9 PEDONS FROM CALDWELL, ELLIS, HUNT, WILLIAMSON AND COOKE COS., TEXAS.
B RATINGS BASED ON NATIONAL SOILS HANDBOOK, SEC. 403.
C WILDLIFE RATINGS BASED ON SOILS MEMORANDUM-74, JAN. 1972.
D CLAYPAN PRAIRIE RANGE SITE.

SOIL INTERPRETATIONS RECORD

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

34C Falba variant loamy fine sand, 1 to 5 percent slopes

ESTIMATED SOIL PROPERTIES

DEPTH (IN)	USDA TEXTURE	UNIFIED	AASHO	FRACT. > 3 IN. (PCT)	PERCENT OF MATERIAL LESS THAN 3 IN. PASSING SIEVE 4	10	40	200	LIQUID LIMIT	PLASTICITY INDEX
0-16	LFS	SM, SM-SC	A-2-4	0	85-100	80-100	50-75	15-35	<25	NP-6
16-33	SC, C	CH	A-7	0	98-100	95-100	90-100	75-95	51-7[illegible]	36-68
33-53	SCL, CL	CH, CL	A-6, A-7	0	98-100	95-100	80-100	51-95	34-[illegible]	21-48
53-72	WEATHERED BEDROCK									

DEPTH (IN)	CLAY (PCT OF <2MM)	MOIST BULK DENSITY (G/CM³)	PERMEABILITY (IN/HR)	AVAILABLE WATER CAPACITY (IN/IN)	SOIL REACTION (pH)	SALINITY (MMHOS/CM)	SHRINK-SWELL POTENTIAL	EROSION FACTORS K	T	WIND EROD. GROUP	ORGANIC MATTER (PCT)	CORROSIVITY STEEL	CONCRETE
SAME DEPTH AS ABOVE	2-10		2.0-6.0	0.07-0.11	5.6-6.5	-	VERY LOW	.24	5	-	<1	HIGH	MODERATE
	35-50		<0.06	0.16-0.18	4.5-5.5	-	HIGH	.32					
	30-40		<0.06	0.16-0.18	4.5-5.5	-	HIGH	.32					

FLOODING FREQUENCY	DURATION	MONTHS	HIGH WATER TABLE DEPTH (FT)	KIND	MONTHS	CEMENTED PAN DEPTH (IN)	HARDNESS	BEDROCK DEPTH (IN)	HARDNESS	SUBSIDENCE INITIAL (IN)	TOTAL (IN)	HYD GRP	POTENTIAL FROST ACTION
NONE			0-1.5	PERCHED	OCT-MAY	-		40-60	SOFT			D	

SANITARY FACILITIES

SEPTIC TANK ABSORPTION FIELDS	SEVERE-WETNESS, PERCS SLOWLY
SEWAGE LAGOONS	SEVERE-WETNESS
SANITARY LANDFILL (TRENCH)	SEVERE-WETNESS, TOO CLAYEY
SANITARY LANDFILL (AREA)	SEVERE-WETNESS
DAILY COVER FOR LANDFILL	POOR-HARD TO PACK, WETNESS

CONSTRUCTION MATERIAL

ROADFILL	POOR-LOW STRENGTH, WETNESS, SHRINK-SWELL
SAND	IMPROBABLE-EXCESS FINES
GRAVEL	IMPROBABLE-EXCESS FINES
TOPSOIL	POOR-TOO CLAYEY, WETNESS

BUILDING SITE DEVELOPMENT

SHALLOW EXCAVATIONS	SEVERE-WETNESS
DWELLINGS WITHOUT BASEMENTS	SEVERE-WETNESS, SHRINK-SWELL
DWELLINGS WITH BASEMENTS	SEVERE-WETNESS, SHRINK-SWELL
SMALL COMMERCIAL BUILDINGS	SEVERE-WETNESS, SHRINK-SWELL
LOCAL ROADS AND STREETS	SEVERE-LOW STRENGTH, WETNESS, SHRINK-SWELL
LAWNS, LANDSCAPING, AND GOLF FAIRWAYS	SEVERE-WETNESS

WATER MANAGEMENT

POND RESERVOIR AREA	MODERATE-DEPTH TO ROCK
EMBANKMENTS DIKES AND LEVEES	SEVERE-HARD TO PACK, WETNESS
EXCAVATED PONDS AQUIFER FED	SEVERE-NO WATER
DRAINAGE	PERCS SLOWLY
IRRIGATION	WETNESS, PERCS SLOWLY
TERRACES AND DIVERSIONS	ERODES EASILY, WETNESS
GRASSED WATERWAYS	WETNESS, ERODES EASILY

REGIONAL INTERPRETATIONS

KEYING ONLY		
RECORD NO.	CONTROL WORD	NO.

UNIT NAME: FALBA VARIANT

UNIT MODIFIER:

RECREATIONAL DEVELOPMENT

CONTROL WORD	NO.		FOOTNOTE	
CAMPS	301	CAMP AREAS	B	SEVERE-WETNESS, PERCS SLOWLY
PICNIC	311	PICNIC AREAS		SEVERE-WETNESS, PERCS SLOWLY

KEYING ONLY			FOOTNOTE	
PLAYGD	321	PLAYGROUNDS		SEVERE-WETNESS, PERCS SLOWLY
PATHS	331	PATHS AND TRAILS		SEVERE-WETNESS

CAPABILITY AND YIELDS PER ACRE OF CROPS AND PASTURE (HIGH LEVEL MANAGEMENT)

CROPHD 451

CONTROL	FOOTNOTE	CLASS-DETERMINING PHASE	CAPABILITY		COTTON LINT (LBS)		GRAIN SORGHUM (BU)		CORN (BU)		IMPROVED BERMUDAGRASS (AUM)							
			NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.
CROPS 341		1-5%	4E		150		40		30		6.0							

WOODLAND SUITABILITY

CONTROL	FOOTNOTE	CLASS-DETERMINING PHASE	ORD SYM	MANAGEMENT PROBLEMS: EROSION HAZARD	EQUIP. LIMIT	SEEDLING MORT'Y.	WINDTH. HAZARD	PLANT COMPET.	POTENTIAL PRODUCTIVITY: COMMON TREES	SITE INDEX	TREES TO PLANT
WOODS 361											

WINDBREAKS

CONTROL	FOOTNOTE	CLASS-DETERMINING PHASE	SPECIES	HT	SPECIES	HT	SPECIES	HT	SPECIES	HT
WINDBR 381										

WILDLIFE HABITAT SUITABILITY

CONTROL	FOOTNOTE	CLASS-DETERMINING PHASE	POTENTIAL FOR HABITAT ELEMENTS: GRAIN & SEED	GRASS & LEGUME	WILD HERB.	HARDWD TREES	CONIFER PLANTS	SHRUBS	WETLAND PLANTS	SHALLOW WATER	POTENTIAL AS HABITAT FOR: OPENLAND WILDLIFE	WOODLAND WILDLIFE	WETLAND WILDLIFE	RANGELAND WILDLIFE
WILDLF 391	C	1-5%	FAIR	GOOD	GOOD	FAIR	-	GOOD	POOR	POOR	GOOD	FAIR	POOR	GOOD

POTENTIAL NATIVE PLANT COMMUNITY (RANGELAND OR FOREST UNDERSTORY VEGETATION)

PHASE 401

CONTROL	FOOTNOTE	COMMON PLANT NAME	PLANT SYMBOL (NLSPN)	PERCENTAGE COMPOSITION (DRY WEIGHT) BY CLASS-DETERMINING PHASE: ALL				
PLANT 411	D	LITTLE BLUESTEM		40				
2		INDIANGRASS		10				
3		BROWNSEED PASPALUM		10				
4		PURPLETOP		5				
5		POST OAK		5				
6		BLACKJACK OAK		5				
7		OTHER PERENNIAL GRASSES		15				
8		OTHER TREES		5				
9		OTHER PERENNIAL FORBS		5				

CONTROL	POTENTIAL PRODUCTION (LBS./AC. DRY WT):	
PRODUC 431	FAVORABLE YEARS	5500
2	NORMAL YEARS	4000
3	UNFAVORABLE YEARS	2500

FOOTNOTES

CONTROL	SYM.	FOOTNOTES
NOTES 441	A	ESTIMATES BASED ON TEST DATA OF SIMILAR SOILS
2	B	RATINGS BASED ON NATIONAL SOILS HANDBOOD, SEC. 403
3	C	WILDLIFE RATINGS BASED ON SOILS MEMORANDUM-74, JAN. 1972
4	D	SANDY LOAM RANGE SITE

SOIL INTERPRETATIONS RECORD

130B Mabank Variant fine sandy loam, 0 to 2 percent slopes

ESTIMATED SOIL PROPERTIES

		FOOTNOTE	DEPTH (IN)	USDA TEXTURE	UNIFIED	AASHO	FRACT. >3 IN. (PCT)	PERCENT OF MATERIAL LESS THAN 3 IN. PASSING SIEVE 4	10	40	200	LIQUID LIMIT	PLASTICITY INDEX
PROP	041	A	0-15	FSL	SM	A-4	0	95-100	95-100	80-98	40-70	<30	NP-10
	2		15-35	CL, SC	CH, CL, SC	A-6, A-7	0	95-100	95-100	85-100	45-80	35-55	20-30
	3		35-60	SCL, CL	CL	A-6, A-7	0	85-100	80-100	80-100	35-80	30-65	18-25
	4												
	5												
	6												

		DEPTH (IN)	CLAY (PCT OF <2MM)	MOIST BULK DENSITY (G/CM³)	PERMEABILITY (IN/HR)	AVAILABLE WATER CAPACITY (IN/IN)	SOIL REACTION (pH)	SALINITY (MMHOS/CM)	SHRINK-SWELL POTENTIAL	EROSION FACTORS K	T	WIND EROD. GROUP	ORGANIC MATTER (PCT)	CORROSIVITY STEEL	CONCRETE
PROP	051	SAME DEPTH AS ABOVE	10-25		0.6-2.0	0.11-0.15	5.6-7.3	-	LOW	.43	5	-	1-2	HIGH	MODERATE
	2		35-40		< 0.06	0.12-0.18	7.4-8.4	-	MODERATE	.32					
	3		25-35		0.2-0.6	0.12-0.17	7.9-8.4	-	MODERATE	.32					
	4														
	5														
	6														

		FLOODING FREQUENCY	DURATION	MONTHS	HIGH WATER TABLE DEPTH (FT)	KIND	MONTHS	CEMENTED PAN DEPTH (IN)	HARDNESS	BEDROCK DEPTH (IN)	HARDNESS	SUBSIDENCE INITIAL (IN)	TOTAL (IN)	HYD GRP	POTENTIAL FROST ACTION
PROP	061	NONE			0.6-1.0	PERCHED	DEC-MAR			760		-		D	-

SANITARY FACILITIES

			FOOTNOTES	
SEPTIC	071	SEPTIC TANK ABSORPTION FIELDS	B	SEVERE-PERCS SLOWLY
LAGOON	081	SEWAGE LAGOONS		SLIGHT
TRENCH	091	SANITARY LANDFILL (TRENCH)		MODERATE-TOO CLAYEY
SANARE	101	SANITARY LANDFILL (AREA)		SLIGHT
COVER	111	DAILY COVER FOR LANDFILL		FAIR-TOO CLAYEY

CONSTRUCTION MATERIAL

KEYING ONLY			FOOTNOTES	
FILL	191	ROADFILL	B	POOR-LOW STRENGTH
SAND	201	SAND		IMPROBABLE - EXCESS FINES
GRAVEL	211	GRAVEL		IMPROBABLE-EXCESS FINES
SOIL	221	TOPSOIL		POOR-TOO CLAYEY

BUILDING SITE DEVELOPMENT

			FOOTNOTES	
EXCAV	121	SHALLOW EXCAVATIONS	B	SLIGHT
DWEL	131	DWELLINGS WITHOUT BASEMENTS		MODERATE-SHRINK-SWELL
DWEL	141	DWELLINGS WITH BASEMENTS		MODERATE-SHRINK-SWELL
BLDGS	151	SMALL COMMERCIAL BUILDINGS		MODERATE-SHRINK-SWELL
ROADS	161	LOCAL ROADS AND STREETS		SEVERE-LOW STRENGTH
LAWNS	171	LAWNS, LANDSCAPING, AND GOLF FAIRWAYS		SLIGHT

WATER MANAGEMENT

			FOOTNOTES	
PONDRS	231	POND RESERVOIR AREA	B	SLIGHT
DIKES	241	EMBANKMENTS DIKES AND LEVEES		SLIGHT
PONDAQ	251	EXCAVATED PONDS AQUIFER FED		SEVERE-NO WATER
DRAIN	261	DRAINAGE		PERCS SLOWLY
IRRIG	271	IRRIGATION		PERCS SLOWLY
TERRAC	281	TERRACES AND DIVERSIONS		PERCS SLOWLY
WATERW		GRASSED WATERWAYS		PERCS SLOWLY

REGIONAL INTERPRETATIONS

		FOOTNOTES	
REGION	181		
	2		
	3		
	4		

UNIT NAME MASANK VARIANT RECREATIONAL DEVELOPMENT
UNIT MODIFIER:

KEYING ONLY CONTROL WORD	NO.		FOOTNOTE	
CAMPS	301	CAMP AREAS	B	SEVERE-PERCS SLOWLY
PICNIC	311	PICNIC AREAS		SEVERE-PERCS SLOWLY
PLAYGD	321	PLAYGROUNDS		SEVERE-PERCS SLOWLY
PATHS	331	PATHS AND TRAILS		SEVERE-ERODES EASILY

CAPABILITY AND YIELDS PER ACRE OF CROPS AND PASTURE (HIGH LEVEL MANAGEMENT)

CONTROL WORD	NO.	CLASS-DETERMINING PHASE	CAPABILITY		COTTON LINT (LBS)		GRAIN SORGHUM (BU)		CORN (BU)		IMPROVED BERMUDAGRASS (AUM)							
CROPHD	451		NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.
CROPS	341	0-2%	3E		330		55		40		6.0							

WOODLAND SUITABILITY

CONTROL WORD	NO.	CLASS-DETERMINING PHASE	ORD SYM	MANAGEMENT PROBLEMS: EROSION HAZARD	EQUIP. LIMIT	SEEDLING MORT'Y.	WINDTH. HAZARD	PLANT COMPET.	POTENTIAL PRODUCTIVITY: COMMON TREES	SITE INDEX	TREES TO PLANT
WOODS	361										

WINDBREAKS

CONTROL WORD	NO.	CLASS-DETERMINING PHASE	SPECIES	HT	SPECIES	HT	SPECIES	HT	SPECIES	HT
WINDBR	381									

WILDLIFE HABITAT SUITABILITY

CONTROL WORD	NO.	FOOTNOTE	CLASS-DETERMINING PHASE	POTENTIAL FOR HABITAT ELEMENTS: GRAIN & SEED	GRASS & LEGUME	WILD HERB.	HARDWD TREES	CONIFER PLANTS	SHRUBS	WETLAND PLANTS	SHALLOW WATER	POTENTIAL AS HABITAT FOR: OPENLAND WILDLIFE	WOODLAND WILDLIFE	WETLAND WILDLIFE	RANGELAND WILDLIFE
WILDLF	391	C	ALL	FAIR	GOOD	GOOD	GOOD		GOOD	POOR	POOR	GOOD	-	POOR	GOOD

POTENTIAL NATIVE PLANT COMMUNITY (RANGELAND OR FOREST UNDERSTORY VEGETATION)

CONTROL WORD	NO.	FOOTNOTE	COMMON PLANT NAME	PLANT SYMBOL (NLSPN)	PERCENTAGE COMPOSITION (DRY WEIGHT) BY CLASS-DETERMINING PHASE: ALL
PHASE	401				
PLANT	411	D	LITTLE BLUESTEM	ANSC2	20
	2		BIG BLUESTEM	ANGE	15
	3		INDIANGRASS	SONU2	15
	4		VIRGINIA WILDRYE	ELVI3	5
	5		OTHER PERENNIAL FORBS	PPFF	5
	6		OTHER TREES	TTTT	5
	7		TEXAS NEEDLEGRASS	STLE5	5
	8		TORREY SILVER BLUESTEM	ANSAT	5
	9		MEADOW DROPSEED	SPASH	5
	421		SWITCHGRASS	PAV12	10

CONTROL WORD	NO.	POTENTIAL PRODUCTION (LBS./AC. DRY WT):	ALL
PRODUC	431	FAVORABLE YEARS	6000
	2	NORMAL YEARS	5000
	3	UNFAVORABLE YEARS	3000

FOOTNOTES

CONTROL WORD	NO.	SYM.	FOOTNOTES
NOTES	441	A	ESTIMATES BASED ON TEST DATA OF SIMILAR SOILS
	2	B	RATINGS BASED ON NATIONAL SOILS HANDBOOK, SEC. 403
	3	C	WILDLIFE RATINGS BASED ON SOILS MEMORANDUM-74, JAN. 1972
	4	D	CLAYPAN PRAIRIE SITE

Klump Grocery

Klump Grocery - Round Top

APPENDIX E

BIOLOGY

EVALUATION OF HABITAT QUALITY

1.0 INTRODUCTION

The development of a reclamation plan or a fish and wildlife plan requires a recognition of existing habitat quality and, by inference, the ability of those habitats to support wildlife. The procedure selected for evaluating terrestrial and aquatic habitat quality in the Cummins Creek Project Area was that of the U.S.D.A. - Soil Conservation Service - Salina, Kansas (1980).

2.0 HABITAT EVALUATION PROCEDURES

2.1 FIELD PROCEDURE FOR TERRESTRIAL HABITAT EVALUATION

There are a total of 5 terrestrial habitat communities in the Cummins Creek Project Area - Cropland, Range (or Grazingland), Pasture, Woodland (Upland and Riparian), and Odd Areas (oil well pads, gravel pits, old field habitat and industrial/commercial/residential areas). In addition, there are two aquatic habitat zones, the water zone and the bank zone.

Each terrestrial habitat community within the evaluation area was rated on a scale of 1 to 10. A 10 value habitat represents the highest year-round quality, quantity and diversity a vegetative community can achieve. Vegetative diversity may be present in the form of species composition, age class, or growth form, or any combination of these, depending on the habitat type.

All evaluations were made purely on the basis of how well the habitat provided for wildlife at the present time. Three evaluations, including present, future without, and future with the project, were undertaken.

Interspersion, a measure of the number of adjacent habitats, was rated as a separate entity for all habitat communities, except cropland, bank, and open water zones. The interspersion value was added to the quality rating of each separate parcel of habitat evaluated; however, a habitat's R value could not exceed 10 regardless of the level of interspersion.

2.1.1 Cropland Evaluation

Cropland is defined as an area used primarily for the production of row crops, small grain, legumes, or domestic annual forage crops.

Regardless of the crop grown, cropland is subjected to an annual major disturbance which results in poor wildlife habitat during some part of the year. Cropland provides dependable cover for only a short time but can provide abundant food seasonally.

In some areas, parcels of abandoned cropland exist. Such lands were in various stages of succession, some of which could not be classed as one of the standard habitat communities. For the purposes of recording, abandoned cropland parcels of more than 3 acres on which succession had not reached a stage to allow reclassifying were shown under "Cropland" and the proper rating assigned.

Parcels of abandoned cropland of 3 acres or less were considered odd areas and rated as such.

On parcels of abandoned cropland of more than 3 acres where succession had reached a stage to permit classifying as one of the standard habitat communities, the quality rating followed criteria for the appropriate habitat.

Regardless of the crop grown, cropland undergoes major disturbances (tilling and harvesting) annually resulting in poor terrestrial habitat during some part of the year. Cropland seldom provides dependable cover but may provide abundant food during part of the year. Due to these limitations, a high cropland rating could only be achieved if it provided food, some cover, and had a high level of interspersion. Knowledge of local farming practices and professional judgment formed the basis for rating, but cropland never received a rating higher than 5.0 without documentation.

CROPLAND EVALUATION KEY

Components	Rating
Cropland with 4 or more habitat communities adjacent:	
Row Crop & Alfalfa	5
All other crops	4
Cropland with 2 to 3 habitat communities adjacent:	
Row Crop & Alfalfa	4
All other crops	3
Cropland with 0 to 1 habitat community adjacent:	
Row Crop & Alfalfa	2
All other crops	1

NOTE: Ratings higher than 5.0 must be documented on the field record form. Do not add an interspersion value.

2.1.2 Range Evaluation

Range (Grazingland) is an area of native grasses, grasslike plants, forbs, and shrubs. The area may be either naturally occurring or seeded by man. Range may be used for either grazing or hay.

RANGE EVALUATION KEY

	Rating
Condition class* by site:	
Good	7 to 8
Excellent	5 to 6
Fair	3 to 4
Poor	2 to 3
Quantity and quality of forbs or woody plants with wildlife value	-1 to +3
Excessive use	-1 to -2

*Condition class was determined by comparing present plant community with what the site is capable of producing (potential) in climax vegetation as follows:

Excellent condition has 76 to 100% of the potential climax vegetation present.

Good condition has 51 to 75% of the potential climax vegetation present.

Fair condition has 26 to 50% of the potential climax vegetation present.

Poor condition has 0 to 25% of the potential climax vegetation present.

The total quality rating cannot exceed 10 points.

2.1.2 Range Evaluation

Range (Grazingland) is an area of native grasses, grasslike plants, forbs, and shrubs. The area may be either naturally occurring or seeded by man. Range may be used for either grazing or hay.

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*Condition class was determined by comparing present plant community with what the site is capable of producing (potential) in climax vegetation as follows:

Excellent condition has 76 to 100% of the potential climax vegetation present.

Good condition has 51 to 75% of the potential climax vegetation present.

Fair condition has 26 to 50% of the potential climax vegetation present.

Poor condition has 0 to 25% of the potential climax vegetation present.

The total quality rating cannot exceed 10 points.

2.1.3 Pasture Evaluation

Pasture is an area of domestic perennial grass. Pure stands of the domestic perennial grasses are of relatively low value to terrestrial wildlife. Their growth form and recommended use essentially eliminates dependable protective cover. For this reason, ratings higher than 6.0 for warm season and 5.0 for cool season grasses had to be documented on the field record form.

Any area seeded to annual grasses, regardless of their use or purpose, were rated as cropland.

PASTURE EVALUATION KEY

Components	Rating
Grass stand in good condition 1/ with some desirable annual and perennial forbs present:	
Warm season pasture	5.5
Cool season pasture	4.5
Grass stand in fair condition 1/ with more of the less desirable annual and perennial forbs present than above:	
Warm season pasture	4.0
Cool season pasture	3.5
Grass stand in excellent condition 1/ with very few perennial or annual forbs present:	
Warm season pasture	3.5
Cool season pasture	3.0
Grass stand in poor condition 1/ with abundance of poor quality annual weeds and grasses and bare ground:	
Warm and cool season pasture	1.0
Same condition as above with more desirable annual grass, forbs, and some small young woody habitat:	
Warm and cool season pasture	2.0

Any of the above with some established woody species:
Add 0.5

Ratings higher than 6.0 for warm season and 5.0 for cool season pastures must be documented.

1/ Based upon degree of management and grasses present.

2.1.4 Woodland Evaluation

Definition

Woodland is an area 1 acre or larger and at least 100 feet wide that is naturally vegetated and dominated by tree species having a canopy cover greater than 25 percent.

Woody invasion on grassland or abandoned cropland is not considered woodland unless the tree canopy cover is greater than 50 percent.

Two categories of woodland were identified:

1. Riparian Woodland - Those woodlands whose growth are influenced by water levels. They usually occur along streams, rivers, lakes, or watercourses and were most readily identified where floodplains exist. They may also extend along drainageways that have no floodplain but where water is available.

2. Upland Woodland - All naturally occurring timber not associated with floodplain, lake, stream, or water levels.

WOOLAND EVALUATION KEY

Species Composition	Rating
4-5 species groups	6 to 10
Nut or mast + 2 other species groups	3 to 6
2-3 species groups, no nut or mast	1 to 3
1-2 species groups, no nut or mast	1

Plant Form Composition

- *Trees over 25' tall
- *Trees 3' to 25'
- *Trees Up to 3' tall
- *Shrubs
- *Vines
- *Grass
- *Forbs
- *Debris and/or Standing Dead
- *Den Trees
- *Trees over 12" dbh

Rating*

Rate each category as:

Abundant = 3 pts.
Common = 2 pts.
Sparse = 1 pt.
Absent = 0 pts.

WOODLAND QUALITY RATING

$$\frac{\text{Total Component Pts. (40 possible)}}{4} = R$$

2.1.5 Odd Area Evaluation

Definition

Odd areas include small areas (usually less than 3 acres) which generally do not meet the criteria of other habitat communities. Odd areas include disturbed areas, farmsteads, field corners, small abandoned cropfields, old field communities, vegetated gullies, permanently vegetated fence rows or field borders, small windbreaks, or any other such area which provides wildlife food and/or cover and adds vegetative diversity. Odd areas evaluated in the Cummins Creek Project Area primarily included oil well pads, abandoned or working gravel pits, old fields, and/or industrial/commercial/-residential areas.

ODD AREA EVALUATION KEY

Components	Rating
Woody Vegetation	
Abundant trees, shrubs, vines; all age; excellent food/cover; ungrazed	5
Woody species abundant; even-all age; food/cover good-excellent	4
Woody species common; even-all age; food/cover good	3
Woody species sparce; even-all age; food/cover fair	2
Woody species sparce; cover poor due to grazing or other disturbance	1
Woody species absent	0
Herbaceous Vegetation	
Abundant perennial native grass & forbs; ungrazed; food & cover excellent	5
Abundant native vegetation; light-no grazing; food & cover good	4
Native vegetation common; moderate grazing; annuals/increasers established; food/cover fair	3
Native vegetation sparse; introduced grass may be established; mod-heavy grazing; food/cover fair-poor	2
Introduced vegetation abundant; heavy graze; food/cover poor	1

Total Points = Rating
(10 possible)

2.2 FIELD PROCEDURES FOR MEASURING TERRESTRIAL HABITAT INTERSPERSION

Interspersion was rated as a separate entity and added to the value for each habitat type except cropland, bank and water zones. The number of adjoining habitat communities was determined for each habitat studied, and the applicable interspersion value was added to the quality rating to determine R. In no case could R exceed 10 regardless of level of interspersion.

INTERSPERSION KEY

Adjacent Habitats Within Survey Area	Interspersion Value
4 or more additional habitat communities	+1.5
3 additional habitat communities	+1.0
2 additional habitat communities	+0.5
1 additional habitat community	0.0
All one community	-0.5

2.3 FIELD PROCEDURES FOR AQUATIC HABITAT EVALUATION

2.3.1 Introduction

Distinct types of aquatic-related (Riparian Zone) habitats occur (Figure 1). Many species use all of the Riparian Zone while others show preference for only one. Bank zones and water zones occur along and around streams, wetlands, ponds, and other open water areas.

2.3.2 Bank Zone Evaluation

Banks have high value to both terrestrial and semiaquatic wildlife and are an easily identifiable habitat community. Species dependent upon this habitat include mink, raccoon, muskrat, deer, beaver, and a variety of shorebirds. Bank evaluations were made for streams and ponds. The area evaluated was from the average waterline up to the top of the first bank (that area directly influenced by extra moisture).

BANK ZONE EVALUATION KEY (STREAM, LAKE AND POND)

Components	Rating
Bank Habitat:	
Excellent	4
Good	3
Fair	2
Poor	1
Continuity*	1 to 4
Bank Diversity:	
Traverses 3+ habitats	2
Traverses 1-2 habitats	1

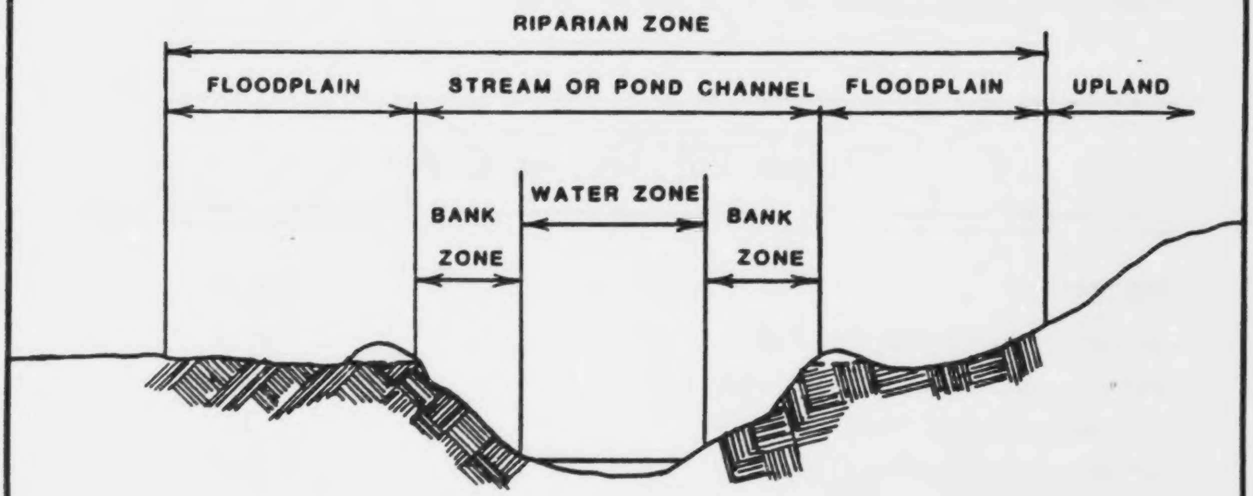
Channelization - If present on streams, subtract up to 2 points depending on channel condition.

*Continuity refers to the capability of the bank to provide travel lanes, habitat edge, and food and cover. Banks with a high continuity rating contained good cover and included continuous travel lanes.

Total Points = Rating
(10 possible)

FIGURE 1

RIPARIAN ZONE HABITATS


RIPARIAN ZONE
FLOODPLAIN
STREAM OR POND CHANNEL
FLOODPLAIN
UPLAND
BANK ZONE
WATER ZONE
BANK ZONE

2.3.3 Water Zone Evaluation

The water zone is composed of shallow water and open water areas. The shallow water zone and associated aquatic vegetation is important to waterfowl and semiaquatic terrestrial wildlife. Species dependent upon this habitat include mink, muskrat, ducks, geese, other waterfowl, turtles, and frogs.

The boundary between the shallow water zone and open water areas is a line at the 3-foot depth.

Water zone evaluations were conducted for perennial stream, reservoirs, ponds, and seasonally flooded areas which occur within the project area. The permanent pool to a depth of 3 feet was considered the water zone for reservoirs, ponds, and seasonally flooded areas.

WATER ZONE EVALUATION KEY
(STREAM, LAKE, POND, AND WETLAND)

Components	Rating
Submerged vegetation (S,L,P,W)	0 to 1
Emergent vegetation present (S,L,P,W)	0 to 3
Open water present (wetland only)	1
Permanent water present (S,L,P,W)	0 to 2
Control of water level (applicable to lake, pond, and wetland only)	2
Water quality (S,L,P,W)	1 to 2
Free flowing water, pools, riffles, etc., present (streams only)	1 to 2

Total Points = Rating
(10 possible)

6.5 FISH AND WILDLIFE PLAN

A fish and wildlife plan identifies the means by which fish and wildlife resources within the permit area will be maintained or enhanced as a result of reclamation. Section 3 of this document provides an overview of the environmental setting of the permit area, an inventory of the habitats and fish and wildlife species present, and a description of any special features of the area. The reclamation plan provided a description of the proposed reclamation within the impacted area. This subsection provides a description of how reclamation will be performed to specifically enhance wildlife values.

6.5.1 Enhancement of Terrestrial Vegetation for Fish and Wildlife

The reclamation plan for the mine will lead to the establishment of a set of vegetation categories and habitats with enhanced wildlife value. Improvement of the quality of habitats (for example, the substitution of higher quality woodland species for some of the existing vegetation) will also increase the utility of the habitat. Land-use practices that will be implemented based upon site specific conditions include the following:

° Land-Use Option: Cropland

- Food and cover plantings along fence rows, roads, drainageways
- Integration of legumes with crops
- Liming and fertilizing
- Cover crops
- Stubble/mulch tillage
- Delaying mowing of headlands, roadsides, and watercourses until after the nesting season

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- Land-Use Option: Cropland
    - Food and cover plantings along fence rows, roads, drainageways
    - Integration of legumes with crops
    - Liming and fertilizing
    - Cover crops
    - Stubble/mulch tillage
    - Delaying mowing of headlands, roadsides, and watercourses until after the nesting season

° Land-Use: Pasture

- Food and cover plantings along fence rows, roads, drainageways, and steep slopes
- Livestock grazing within the carrying capacity of the pasture
- Liming and fertilizing
- Reseeding, renovating, or overseeding with legumes
- Building ponds for wildlife and livestock water
- Disking to promote forbs
- Controlled burning

° Land-Use: Grazingland (Range)

- Food and cover plantings along fence row, roads, drainageways, and steep slopes
- Proper grazing and salting
- Watering ponds for wildlife and livestock
- Reseeding with grasses and legumes
- Adequate cross-fencing
- Partial brush removal

° Land-Use: Undeveloped (Woodland)

- Protection from unwanted fire and harmful grazing
- Selective cutting in small woodlands
- Leaving den trees when cutting or thinning timber
- Piling brush near the edge of the woods
- "Release" cuttings to increase production of acorns, nuts, and other tree seeds useful for wildlife food
- Cutting trees out of woodland borders to increase the growth of shrubs for food and cover

It may not be possible to effect all of the above wildlife enhancement procedures in all cases because of the landowner's need to graze domestic livestock. However, the procedures are planned to improve habitat values over that which exists today. The most critical apparent need is to enhance the value of the woodlands to support wildlife. Procedures for enhancement include:

- Selective planting to yield a 40- to 45-percent canopy composed of multiple age groups of timber
- Planting of high-wildlife value plant species in a 30-yard wide ecotonal area around the perimeters of the woodlands
- Placement of artificial nest boxes in appropriate locations for wood ducks, squirrels and other species
- Development of a permanent water supply (excavated pond) at appropriate intervals if a supply does not already exist and the terrain allows development
- Placement of small escape cover areas (brush piles, fallen trees)
- Fencing to exclude or limit livestock grazing
- Interspersion of other habitats around the woodland

6.5.2 Stream Reconstruction to Enhance Fish and Wildlife Values

Reconstruction of existing drainages which pass through the mine area is one of the keys to successful reestablishment of the wildlife balance in the permit area. The riparian habitats along the creeks currently support a relatively diverse assemblage of flora and fauna. The streams themselves, when flowing, support not only an array of aquatic flora and fauna but provide a water source for the terrestrial wildlife of the area. The reclamation plan addresses revegetation of the stream channels. In summary, the channels and associated sideslopes will be planted to grass and legume species capable of tolerating streamflow with minimal erosion. Shrubs and tree species which provide superior food, cover or shelter for wildlife will be planted along the stream channels.

The reconstructed stream channels themselves will be of sufficient width to allow the natural process of erosion and sedimentation to shape a meandering channel. To the extent possible, the original stream channel configuration will be retained. The reestablishment of aquatic flora and fauna will require the development of:

- Resting and hiding areas for fish
- Food producing areas
- Reproduction areas
- Streamside vegetation

The revegetation plan provides for the necessary streamside vegetation. The other needs will be provided by developing "structure" within the channel by such techniques as placement of gravel bars and habitat structures. No attempt will be made to artificially restock the reconstructed stream sections because of their ephemeral or intermittent nature. Natural restocking of plankton and invertebrate species will occur, and fish will move from upstream or downstream areas to occupy the newly created habitat.

6.5.3 Pond and Reservoir Reclamation to Enhance Fish and Wildlife Values

The reclamation plan addresses the proposed revegetation associated with permit area ponds and reservoirs. The reclamation plan will result in the establishment of a series of aquatic-related habitats utilized by deer, waterfowl, furbearers, game birds and other species. Stocking of the ponds and reservoirs will be employed as necessary to maintain or enhance their fishery value. Although fish stocking depends on landowner goals and management philosophy, the most commonly stocked fish in Texas farm ponds are channel catfish, blue catfish, largemouth bass, bluegill, red ear sunfish, and various forage species (threadfin shad, fathead minnows, golden shiners). Ponds and reservoirs stocked with these species and properly managed will provide a stable fish resource.

6.5.4 Endangered or Threatened Wildlife

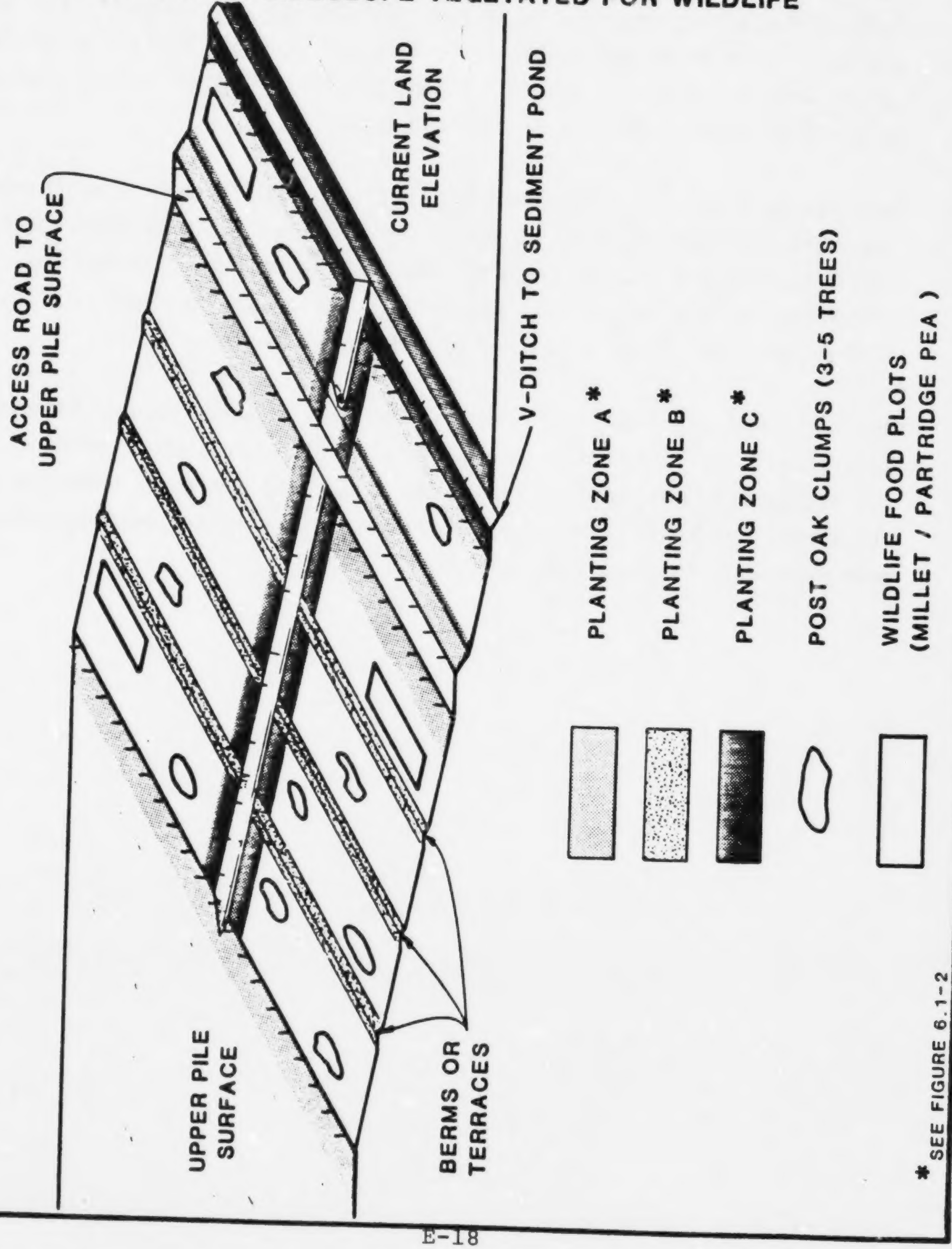
Although no endangered or threatened wildlife species permanently exist in the Cummins Creek Mine Permit Area, it is possible that some species may temporarily utilize the area for feeding purposes or other specific life support functions, but only on a migratory basis. For example, the wood stork, a Texas protected species, has been infrequently sighted within the permit area while on its migratory flight pattern. Another species that may possibly be seen in the area is the bald eagle.

Reclamation plans for enhancement of fish and wildlife habitat will ensure the least negative impact of mining on any endangered or threatened species. Providing unique habitats, creating more diverse ecological conditions, and restoring the land to equal or better than its premine productivity potential should benefit any threatened or endangered species.

Any additional sightings or locating of habitats of threatened or endangered species will be reported to appropriate wildlife regulatory authorities. All attempts will be made to reduce the impacts of mining on endangered or threatened species by appropriate reclamation planning and land-use management within the Cummins Creek Mine Permit Area.

FIGURE 6.1-1

CUMMINS CREEK MINE
TYPICAL CROSS SECTION OF PERMANENT OVERBURDEN STOCKPILE SIDESLOPE VEGETATED FOR WILDLIFE


ACCESS ROAD TO UPPER PILE SURFACE
CURRENT LAND ELEVATION
V-DITCH TO SEDIMENT POND
UPPER PILE SURFACE
BERMS OR TERRACES
PLANTING ZONE A*
PLANTING ZONE B*
PLANTING ZONE C*
POST OAK CLUMPS (3-5 TREES)
WILDLIFE FOOD PLOTS (MILLET / PARTRIDGE PEA)

* SEE FIGURE 6.1-2

FIGURE 6.1-4

CUMMINS CREEK MINE PROPOSED RESERVOIR RECLAMATION PLANTING TO ENHANCE FISH AND WILDLIFE USAGE

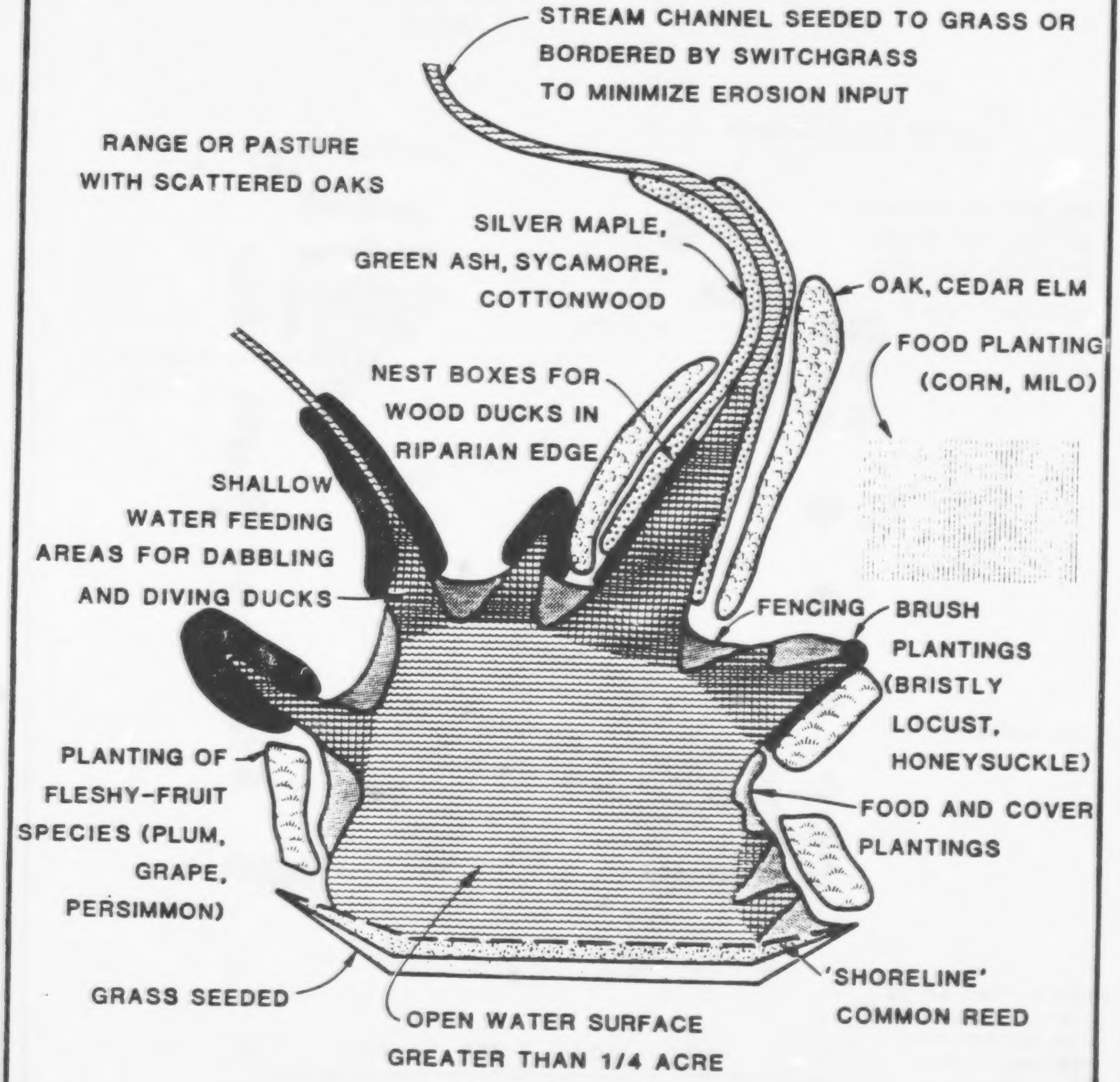
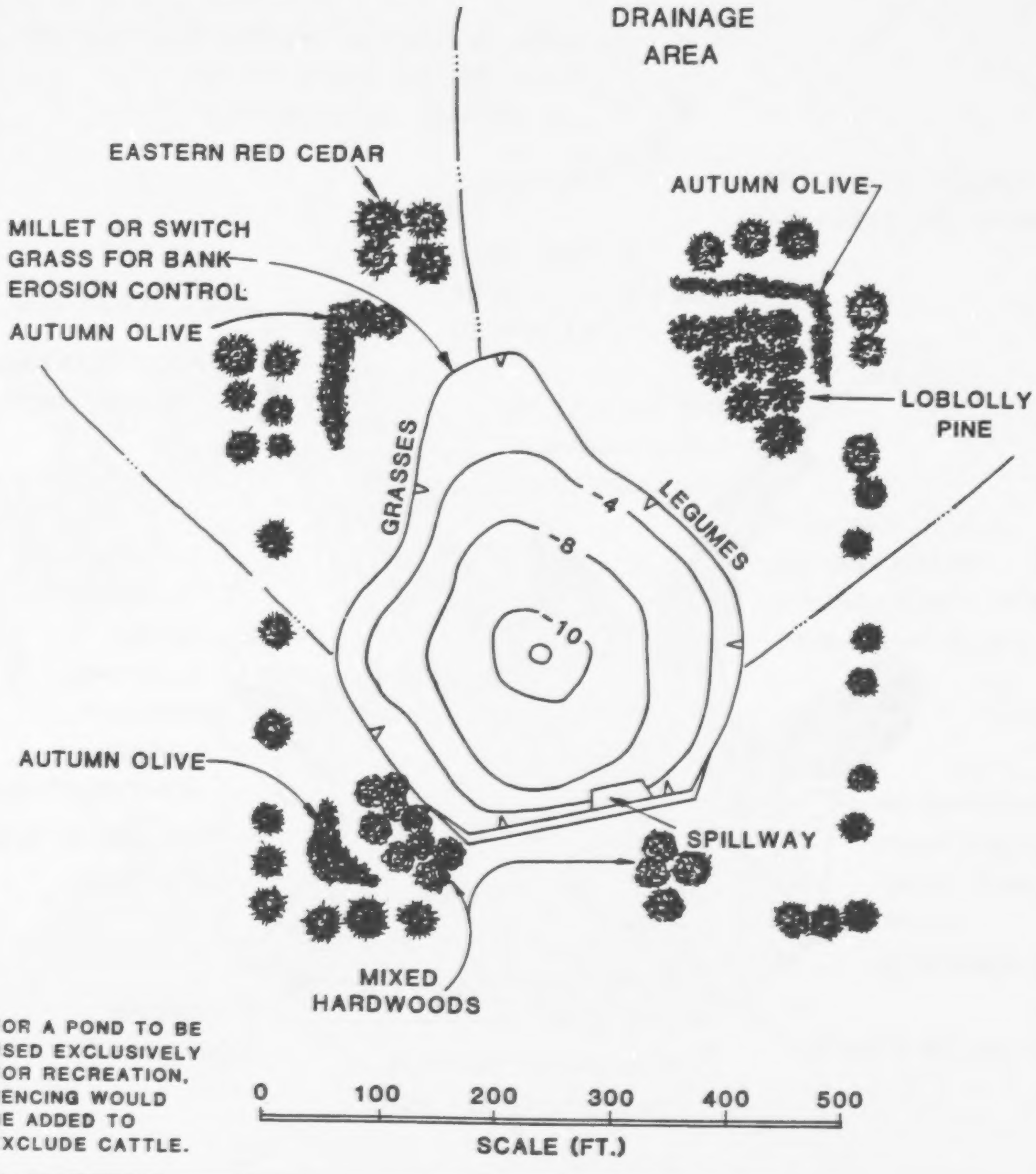

STREAM CHANNEL SEEDED TO GRASS OR BORDERED BY SWITCHGRASS TO MINIMIZE EROSION INPUT
RANGE OR PASTURE WITH SCATTERED OAKS
SILVER MAPLE, GREEN ASH, SYCAMORE, COTTONWOOD
OAK, CEDAR ELM
FOOD PLANTING (CORN, MILO)
NEST BOXES FOR WOOD DUCKS IN RIPARIAN EDGE
SHALLOW WATER FEEDING AREAS FOR DABBLING AND DIVING DUCKS
FENCING
BRUSH PLANTINGS (BRISTLY LOCUST, HONEYSUCKLE)
PLANTING OF FLESHY-FRUIT SPECIES (PLUM, GRAPE, PERSIMMON)
FOOD AND COVER PLANTINGS
GRASS SEEDED
'SHORELINE' COMMON REED
OPEN WATER SURFACE GREATER THAN 1/4 ACRE

FIGURE 6.1-5

CUMMINS CREEK MINE
PROPOSED RECLAIMED POND FOR RECREATION WHICH HAS HIGH FISH AND WILDLIFE VALUE*


DRAINAGE
AREA
EASTERN RED CEDAR
AUTUMN OLIVE
MILLET OR SWITCH
GRASS FOR BANK
EROSION CONTROL
AUTUMN OLIVE
LOBLOLLY
PINE
GRASSES
LEGUMES
-4
-8
-10
AUTUMN OLIVE
SPILLWAY
MIXED
HARDWOODS
0
100
200
300
400
500
SCALE (FT.)

*FOR A POND TO BE USED EXCLUSIVELY FOR RECREATION, FENCING WOULD BE ADDED TO EXCLUDE CATTLE.

TABLE 6.2-3
CUMMINS CREEK MINE
REVEGETATION SEED MIXTURES*

Pasture

Coastal bermudagrass (*Cynodon dactylon*)	48 bushels of sprigs/acre

Grazingland

Mixture 1

	lbs PLS/acre
Common Bermudagrass (*Cynodon dactylon*)	2
Kleingrass (*Panicum coloratum*)	2
Bahiagrass (*Paspalum notatum*)	2
Medio bluestem (*Andropogon nodosus*)	1
Arrowleaf clover (*Trifolium vesiculosum*)	1
Total	8

Mixture 2

	lbs PLS/acre
Green sprangletop (*Leptochloa dubia*)	2
Buffelgrass (*Cenchrus ciliarus*)	2
Little bluestem (*Andropogon scoparius*)	2
Switchgrass (*Panicum virgatum*)	2
Subterranean clover (*Trifolium subterraneum*)	1
Total	9

Mixture 3

	lbs PLS/acre
Old World bluestem (*Dichanthium* spp.)	1
Buffalograss (*Buchloe dactyloides*)	2
Sideoats grama (*Boutelous curtipendula*)	3
Indiangrass (*Sorghastrum nutans*)	2
Arrowleaf clover (*Trifolium vesiculosum*)	1
Total	9

Disturbed Areas

	lbs PLS/acre
Common Bermudagrass (*Cynodon dactylon*)	2
Bahiagrass (*Paspalum notatum*)	2
Kleingrass (*Panicum coloratum*)	2
Lovegrass (*Eragrostis curvula*)	1
Vetch (*Vicia sp.*)	1
Total	8

TABLE 6.2-3
(Continued)

Fish and Wildlife Habitat

	lbs PLS/acre
Switchgrass (Panicum virgatum)	4
Indiangrass (Sorghastrum nutans)	4
Arrowleaf clover (Trifolium vesiculosum)	2
Maximilian sunflower (Helianthus maximiliani)	1
Illinois bundleflower (Desmanthus illinoensis)	1
Total	12

Aquatic Vegetation**

Cattail (Typha spp.)
Shoreline Common reed (Phragmites australis)
Reed canary grass (Phalaris arundinacea)
Japanese millet (Echinochloa crusgalli)

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* Seeding rates are based on drill seed application. Broadcast seeding application should require doubling the seed drill application rate. Legumes will be drill seeded during the fall season.

** Seed mixtures were developed on the basis of seeding approximately 100 pure live seeds per square foot. All mixtures are in pounds of pure live seed (PLS). All seed mixtures and planting requirements are approximations.

*** Aquatic vegetation will be planted according to specified recommendations.

TABLE 6.2-4
CUMMINS CREEK MINE
TREE, SHRUB AND VINE RECLAMATION SPECIES

Common Name	Scientific Name	Wildlife Food Value[a]	Wildlife Cover Value[a]	Comments
	Trees			
Eastern red cedar	*Juniperus virginiana*	1	1	Good fenceline planting
Loblolly pine	*Pinus taeda*	1	1	Sandy area planting
Boxelder	*Acer negundo*	3	2	Fast growing
Silver maple	*Acer saccharinium*	3	2	Streamside planting
Pecan	*Carya illinoisensis*	1	2	
Texas black hickory	*Carya texana*	1	2	
Sugarberry, sugar hackberry	*Celtis laevigata*	1	2	
Redbud	*Cercis canadensis*	2	2	
Common persimmon	*Diospyros virginiana*	1	2	
Green ash	*Fraxinus pennsylvanica*	2	2	Streamside planting
Black walnut	*Juglans nigra*	1	2	
Sweetgum	*Liquidambar styraciflua*	2	2	Streamside planting
Osage orange	*Maclura pomifera*	3	1	
Red mulberry	*Morus rubra*	1	2	
Eastern cottonwood	*Populus deltoides*	3	2	Streamside planting; fast growth
Lombardy poplar	*Populus nigra*	4	3	Fast growth screening
Black cherry	*Prunus serotina*	1	1	
Prairie crabapple	*Pyrus ioensis*	1	2	
Post oak	*Quercus stellata*	1	1	
Blackjack oak	*Quercus marilandica*	1	1	
Live oak	*Quercus virginiana*	1	1	
Texas red oak	*Quercus texana*	1	1	
Bur oak	*Quercus macrocarpa*	1	1	
Honey locust	*Gleditsia triacanthos*	3	1	
Black locust	*Robinia pseudoacacia*	3	1	Excellent cover, but fierce competitor; use only under controlled conditions
Cedar elm	*Ulmus crassifolia*	2	1	Along water courses

TABLE 6.2-4
(Continued)

Common Name	Scientific Name	Wildlife Food Value[a]	Wildlife Cover Value[a]	Comments
	Shrubs			
Buttonbush	*Cephalanthus occidentalis*	1	1	
Hawthorns	*Crategeus* spp	1	2	Excellent row planting
Russian olive	*Elaeagnus angustifolia*	1	1	Excellent row planting
Autumn olive	*Elaeagnus umbellata*	1	1	Excellent row planting
Possumhaw	*Ilex decidua*	1	1	
Yaupon	*Ilex vomitoria*	1	1	
Wild plum	*Prunus americana*	1	1	Excellent row planting
Wild cherry	*Prunus virginiana*	1	1	Excellent row planting
Pyracantha	*Pyracantha graberi*	1	1	
Bristly locust	*Robinia fertilis*	2	1	Drainageway planting
Multiflora rose	*Rosa multiflora*	1	1	
	Vines			
Purple honeysuckle	*Japanica purpurea*	1	1	
Wild grapes	*Vitis spp.*	1	1	
Dewberry, blackberry	*Rubus spp.*	1	1	

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[a] 1 = Excellent; 2 = Good; 3 = Fair; 4 = Limited

Source: Dickson and Vance, 1981.

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APPENDIX F

CULTURAL AND HISTORIC RESOURCES

THE STATE OF TEXAS

CURTIS TUNNELL
EXECUTIVE DIRECTOR

TEXAS HISTORICAL COMMISSION

P.O. BOX 12276 AUSTIN, TEXAS 78711 (512) 475-3092

March 21, 1985

Mr. Clinton Spotts
U.S. Environmental Protection
Agency
Region VI
1201 Elm Street
Dallas, TX 75270

Re: Cummins Creek
Fayette County, Texas
(EPA, A-6)

Dear Mr. Spotts:

It is the opinion of our office that the cultural resources in the Cummins Creek project area constitutes an historic district eligible for listing on the National Register of Historic Places. We recommend that your agency proceed with the submittal of a concurrance determination of eligibility to the Keeper of the Register.

We look forward to additional consulation on the undertaking under 36 CFR 800.

Sincerely,

LaVerne Herrington

LaVerne Herrington, Ph.D.
Deputy
State Historic Preservation
Officer

NK/LH/mes

RECEIVED
MAR 25 1985

The State Agency for Historic Preservation

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION VI
1201 ELM STREET
DALLAS, TEXAS 75270

Ms. Carol Shull
Keeper of the National Register
of Historic Places
Interagency Resources Division
National Park Service
Department of the Interior
Washington, D.C. 20240

Dear Ms. Shull:

We are requesting your consideration of a concurrence determination of eligibility on the Fayette Power/Rabbs-Cummins Creek Mine Historic District under the terms of 36 CFR 63.3. The proposed project includes two electric power generating units at the Fayette Power Plant, a surface lignite mine, a lignite conveyor belt system, and other facilities such as solid waste disposal area. The project area is within Fayette County of Texas, with exception of any future and existing transmission lines.

The Federal action under consideration by EPA is the issuance of National Pollutant Discharge Elimination System permits for the above facilities. Consideration of such action is under authority of Section 402 of the Clean Water Act. An environmental impact statement is being prepared which addresses direct and indirect impacts, upon the archeological, architectural, historical resources, as well as cultural value.

The National Historic Preservation Act, Section 106 applies to the permit actions proposed. Formal consultation with the Advisory Council on Historic Preservation will be carried out.

An overview of the proposed project, archeological background of the area, and significance of the district are provided as enclosures. Also provided are individual site forms, photographs, completed reports on archeological and historical surveys, and further locational information for the district.

We appreciate your consideration on this matter. If you have any questions, please contact Jeanene Peckham at (214) 767-2716.

Sincerely yours,

Clinton B Spotts

Clinton B. Spotts
Chief, Federal Activities Branch (6ES-F)

Enclosures

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION VI
1201 ELM STREET
DALLAS, TEXAS 75270

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Mr. Bob Fink
Director, Western Division
of Project Review
Advisory Council on Historic
Preservation
730 Simms Street, Room 450
Golden, Colorado 80401

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Dear Mr. Fink:

The Environmental Protection Agency (EPA), Region 6, is involved with considerations on permits for an electric power generation plant and for a lignite surface mine. The generation project is known as the Fayette Power Project; the mine is the Cummins Creek Mine. Both are owned by the Lower Colorado River Authority. The plant, mine, and lignite conveyor system are located in Fayette County. Plant associated transmission lines have been constructed across several adjacent counties and others are proposed.

We have reviewed reports on applicant provided surveys for acheological and historical resources as well as made on-site observations at the project area. In concurrence with the Texas State Historic Preservation Officer, the determination was made that historic and prehistoric resources in the project area constitute a Historic District which is eligible for the National Register of Historic Places. The district is designated the Fayette Power/Rabbs-Cummins Creek Mine Historic District. This district is significant for the information it may provide on human settlement patterns and lifeways beginning with the Paleoindian Period and extending through the Historic. This area is within the eastern area of the German-Texan Study Unit in the Texas Historical Commission's Resource Protection Planning Process for Texas, developed in 1982. In addition, the District contains three towns and numerous sites eligible for the National Register on their individual merits.

It is our determination that this project has had in the past, and will have in the future, a significant adverse impact on archeological, historical and cultural values resources. Therefore, we request formal consultation with the Advisory Council on the entire undertaking, including the previous FPP permit actions as well as proposals for Units 3 and 4, ancillary facilities, mine and conveyor, in order to comply with the

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National Historic Preservation Act. We have enclosed a Preliminary Case Report for your review. We have enclosed also a Proposal for Agreement for your consideration. This Agreement has been coordinated with the Texas State Historic Preservation Officer.

We are available to discuss this undertaking at your convenience. Your consideration of this matter is appreciated.

Sincerely yours,

Dick Whittington, P.E.
Regional Administrator

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Enclosure

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Fayette Power Plant and Cummins Creek Mine Project

Preliminary Case Report

1. Description of the agency's involvement with the proposed undertaking with citations of the agency's program authority and applicable implementing regulations, procedures, and guidelines:

The Environmental Protection Agency is involved with the undertaking with permit actions as follows:

a. Issuance of new source National Pollutant Discharge Elimination System (NPDES) permits under Section 402 of the Clean Water Act. This Act (33 USC et seq.) authorizes EPA to administer NPDES permits to industries that discharge to waters of the United States. New source regulations were published on January 12, 1979, in 40 Code Federal Regulation (40 CFR) Part 434, 44 CFR 2589.

b. Issuance of the Prevention of Significant Deterioration (PSD) permit for air emissions under responsibility of the Clean Air Act (42 U.S. Code 7470-79). PSD regulations were published in 40 CFR Part 52.

2. Status of this project in the agency's approval process:

For the Cummins Creek Mine and Fayette Power Plant (FPP) Units 3 and 4 and ancillary facilities portions of the undertaking:

a. A draft Environmental Impact Statement (EIS) has been prepared for use in making decisions on the NPDES permit. A draft permit, if any, will be prepared and distributed to the public with a Final EIS. EPA will make a final decision on a permit after a 30-day public review period. The cultural resources on this project will be described in the draft EIS; a determination on eligibility to the National Register of Historic Places will be stated; analysis of impacts will be stated for public review. Comments will be solicited from the public and agencies on the draft EIS and the final EIS.

b. The PSD permit was issued to LCRA for FPP Unit 3 in 1984. FPP Unit 3 is presently under construction; the area of the foundation of Unit 4 is also disturbed.

For the Fayette Power Plant Units 1 and 2 (portion of the undertaking), an NPDES permit was issued in 1979; the air emissions PSD permit was issued in 1979.

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3. Status of this project in the agency's National Environmental Policy Act compliance process and the target date for completion of environmental responsibilities:

a. For the mine and Fayette Power Plant Units 3 and 4:

A draft EIS has been prepared and was made public on about March 1985. A final EIS and Record of Decision will be required subsequent to the Draft EIS, and may be completed about September 1985.

b. For the FPP Units 1 and 2:

A draft and a final Environmental Impact Statement were prepared on power Units 1 and 2, and Cedar Creek Reservoir. These statement were completed in 1978 and May 1979 respectively.

4. A description of the proposed undertaking including, as appropriate, photographs, maps, drawings and specifications:

The Fayette Power Plant and Cummins Creek Mine undertaking is proposed to include construction of a plant of multiple electric power generation units including at least 4 units of 600 MW and 400 MW capacities, transmission lines, a 12.1-mile lignite conveyor system connecting the plant to a mine, a 25,326 acre lignite mine with pits on some 6900 acres with depths to 400 feet, mine ancillary facilities on more than 7,000 acres, a 412 acre ash disposal area, and two cooling reservoirs, one in place now on Cedar Creek (2,400 acres) and an alternative proposed on Baylor Creek (1400 acres). A total of some 32,000 acres is involved without the additional proposed transmission lines. Ancillary facilities include a railroad for transport of western coal to Units 1 and 2, coal crushing/ storage/handling facilities, mine access roads, mine maintenance facilities, earth/ coal haul roads, water diversion ditches, water retention and treatment ponds, permanent spoil storage, transmission lines and power substations.

Major earth disturbance operations include uprooting and removal by bulldozer of trees and brush, excavation and earth movement for formation of ditches, dams, and wastewater treatment ponds, overburden removal by draglines and bucket-wheel excavators, permanent diversion of Cummins Creek, land levelling and scraping for conveyor and transmission lines.

The project plant and mine area is in the uplands of the Colorado River Basin on the southern crest and slopes of the interfluvial divide between Bexar and Wilson counties in the southwest, between the Pineywoods of East Texas, the Gulf Prairie and marshes to the southeast, and the Blackland Prairie. The Colorado River flows approximately 10km south of the plant area. Several tributaries to the Colorado cut this upland region; Baylor Creek and Cedar Creek in the south end, and Cummins Creek and Rabbs Creek in the northern end.

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Attachment 1 includes maps of the project areas and facilities.

5. A description of the National Register or eligible properties affected by the undertaking, including a description of the properties' physical appearance and significance.

The undertaking's currently known 295 cultural resources, including prehistoric and historic properties, include resources of the Fayette Power/Rabbs-Cummins Creeks Mine Historic District. Based on datable tools, the 193 prehistoric sites include occupations from the Paleoindian, Archaic (Early, Middle, and Late), and Late Prehistoric periods. Site types include hunting camps and lithic procurement sites: one kill site including Bison bison remains occurred in the plant area; notably missing are burial sites. Evidence of sites is contained in flint debris, stone tools, middens, and hearths. Many sites listed in surveys initially as light scatters without features have in fact, with testing at depth, produced features, diagnostic artifacts, and deep, stratified cultural deposits. All sites to date are based on surface exposure; effort to find unexposed sites has not yet been made. It is noted elements from the Central Texas Culture, the Coastal Texas, and East Texas Cultures have occurred; but the Fayette County and adjacent areas are not yet defined as to prehistoric culture.

The 102 Historic period elements and information project in the area begin with land grants and early roads in the 1820s, structures date to 1832 and the second German settlement in Texas. Sites include original settler's farmsteads, cemeteries, school sites, log structures and foundation ruins, early water supplies (cisterns and wells), churches, stores, saloons, hotel, and three towns. Many of these sites are eligible for the National Register on their own merits, including cemeteries and the three towns. This geographic area is named in the eastern part of the German-Texan Unit in the Preservation Planning Process by Texas Historical Commission (1982).

The District properties are significant for the new information that can be provided to history about cultural groups, their settlement patterns, subsistence and culture beginning more than 10,000 years ago, and through the Historic Period to the present time.

Attachment 2 contains additional information and photographs on various type sites.

6. A statement explaining why any of the Criteria of Adverse Affect apply:

For the mine and conveyor area:

The criteria (1) through (5) all apply. Example of effects include: (1) Earth will be disturbed by tree clearing, earth moving to form dams and ditches and mining up to 400 feet in depth. This would destroy features, location and setting of many archeological properties at prehistoric and historic sites. Historic structures will be moved or bulldozed down; (2) Some sites, including Historic Cemeteries, will be isolated from the surrounding environment. Some sites will be more exposed to natural elements, to upland as well as stream erosion and would

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be expected to deteriorate; (3) Direct increase of area population by project work force, indirect increase of families and service population with subsequent increases in traffic and noise levels will adversely affect the present rural atmosphere of the three towns. Induced population are expected to bring different cultural values; (4) Relocation of residents from areas to be used by the project leave structures untended, individual's historic knowledge is minimized and not recorded; (5) Historic structures designated in early surveys have been moved without preservation of architectural significance; without appropriate timely protective measures this can be expected again. Regarding cultural value loss, family lifeways will be disrupted, traditions will be broken and discontinued. Dispersal of communities, neighbors, friends, and relatives will occur. Emotional loss could occur where property is lost by people who have stayed with the land over time since ancestral settlement. Objectives of absentee owners and large government/industry expecting gain/benefits provide a conflict.

All the 69 historic sites will be affected directly, or indirectly within the District.

For transmission lines - the following have occurred and can be expected again with out protective stipulations:

Major losses due to tree uprooting and clearing by bulldozer for both centerline and 100-foot right-of-way clearing; leveling for tower pad construction, augering for foundation footings and heavy load traffic. Cultural stratigraphy and fragile subsurface cultural features receive direct structural damage from augering and clearing. Compaction from surface traffic, e.g., bulldozer crossings over or near sites have resulted in soil deformation and subsurface stresses. Tracking, manuevering, and blade scraping damage/destroy insitu (in place) surface materials. Severe effects occur to historic sites from the transmission line construction. Indirect effects to both type sites occur such as from erosional effects where areas are now exposed to direct rainfall, aeolian deflation, change in surface water drainage.

In the past, consultant recommendations for fill or padding of sites were not carried out; LCRA had obtained right to disturb for construction but felt they could not protect an cultural area from use or cover it. In some cases good fill material was considered not readily available.

For the plant and cooling lake areas: The adverse effects were largely direct destruction to the 12 historic sites, all within the historic Biegel Settlement, and 19 prehistoric sites at the plant and Cedar Creek Reservoir. Cemeteries and some structures were moved before excavation and construction on the sites. Three historic sites were recommended outright for nomination to the NRHP by the archeological consultants. Also, complete recordation of architectural features according to the Historic American Buildings Survey (HABS) standards, and submittal of the data to the HABS was recommended. Neither nominations to the Register nor determinations of eligbility were made; appropriate architectural data were not recorded. It is expected the twelve sites all were significant and eligible for the Register for information on locational aspects, patterning by the settlers, site

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contents, lifeways, adaptations, and craftsmanship of the immigrant settlers that only the sites can provide. Some archeological work was undertaken at two sites as the clearing and earth moving began, but was not completed. (Carter and Ragsdale, 1977). The prehistoric sites were affected by earth moving for dam and lake formation, compaction, or inundation. Present condition of those sites inundated is unknown. A sample of the sites was excavated, uncovering a Bison bison kill site. Basis for the sample is unknown.

For this action, all must acknowledge that a large loss in history occurred.

7. Written reviews of the State Historic Preservation Officer concerning the effect on the property:

Note to Reviewers - The Texas State Historic Preservation Officer will make a presentation at the Public Hearing on the Draft EIS regarding significance of the resource and the adverse impacts from the project. A letter will be provided for consultation with the Council.

8. The views of other Federal agencies, state and local governments, and other groups or individuals when known.

(Note to Reviewers - Views on the present NPDES permit actions for the mine and FPP Units 3 and 4, conveyor and ash disposal have not yet been obtained). The following excerpt from the TAS Research Report #59 gives some indication of point of view of those losing historic farmsteads.

"Biegel's Settlement: 1974-1975

About seventy families live on or owned property in the Biegel League and adjacent land when it was announced in early 1974 that the Lower Colorado River Authority had selected a 6,000-acre site between Baylor and Cedar Creeks, 8 miles east of La Grange, on which to construct a coal-burning, electric-generating plant. Other parts of the operation were to include cooling lakes, coal and cinder storage areas, and a railroad spur into the project. The land was acquired through purchase and condemnation procedures, and by the end of 1975 the land owners had all given up their property.

The majority of the land owners were middle-aged and older. Some other holdings, both large and small, were used for ranching and farming, although the owners lived in La Grange, Ellinger, Fayetteville, or Houston. A number of the ranchers had spent their lives building up their herds and improving the land. Some of the people were Houston week-enders. The Charles Polaseks, Sr., the oldest couple affected by the project, had lived on their land all of their married lives (Baker 1974; Mills 1974)

Charlie Polasek, Jr., was born in Biegel's Settlement on the old Gentner-Kroll-Polasek farmstead in the late 1930's. When he married Lorine Malete, from neighboring Fayetteville in the 1950's, they moved onto the old Schutzen Verein site, just up the road from his birthplace. During the following years they built a home, added to the buildings on the homestead, and purchased additional field, pasture, and brush land.

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The Polaseks and their six children were a close-knit family whose cultural-religious ties were centered in St. John's Catholic Church activities in Fayetteville. Their children attended school first in Fayetteville and then in La Grange (Polasek, Jr. 1975).

In addition to his job with a La Grange farm implement sales company, Charlie Polasek, Jr., with the help of his brother-in-law, his wife, and their four sons, ran a custom farming business on neighboring farms. He kept the farm machines running while the others did the plowing, planting, and harvesting. For almost twenty years, ending with the loss of their farmstead in 1975, the Polasek family was a working rural family enterprise. They ran a few cattle of crossed Hereford and Brahma strain, from which they sold the calves. There were no chickens on the place because the coons were too bad; no horses because there was no need for them; but there was farm machinery which the boys of the family had learned to care for in the long shed next to the house (Polasek, Jr. 1975).

The first knowledge Charlie Polasek, Jr., had of the proposed Fayette County power plant project came over the radio one day in March 1974, when he was hauling a newly-purchased young Charolais bull back to his farm. The site first mentioned was Gay Hill, below La Grange. The following day a real estate agent made an offer to buy his place, but it was several months before he was contacted officially by the LCRA. By then, the plant location had been changed to the site between Baylor and Cedar creeks on the Biegel League (Polasek, Jr. 1975).

After the announcement the Polaseks met with some of their neighbors to protest the location of the power plant on their lands. The first meeting was at the Howard Mills' home and the next was held at the Park community. Among those who attended were Bennie and Adolph Schmidt, the Sherwood Cranes, the John Schumachers, and the Ed Sarrazins. They formed the Cedar Creek - Baylor Creek Landowners/Protective Association, a name later changed to the Landowners Protective Association, and they sought to have the plant located on the old government-owned Camp Swift property near Bastrop, a site which had been suggested earlier as a possible location. The association held a number of meetings and placed advertisements in one of the La Grange newspapers which was running a series of articles and letters against the location of the power plant in Fayette County (Fayette County Record June 4, 11: December 19, 1974). As land acquisition for the power plant continued, further letters and articles of protest appeared in the Fayette County Record (April 1, 11; May 9, 16, 1975). However, nothing was changed in the LCRA plans.

Charles Polasek, Jr., had been notified a short time earlier to give up possession of his house and property by May 15, 1975, and when he finally accepted the LCRA's price for his land, he was allowed to buy back what improvements he could move. Only the house, the well-casing and pump remained of the farmstead. The Polaseks bought a new farm on the Old Plum Road west of La Grange. The house, built in the late 1920's, had not been planned to accomodate a family of four boys and a small girl, nor were the few outbuildings comparable to the old Biegel league place. The large machinery shed which Polasek and his friends had built with large spikes during Hurricane Carla was lying disassembled as so much lumber at the new place. In addition, there were no brush

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or hunting lands, and the Coastal Bermuda grass, planted in the field next to the house for the cattle, was not doing well (Polasek, Jr. 1975).

In 1975 it was not easy to replace farm and ranch land in Fayette County. Prices had risen during the past ten years to a high of $1,500.00 an acre for unimproved land. This fact caused a number of Polasek's neighbors to move away. The Howard Mills located ranch land in Blanco County and the Earl Bakers in Somerville County. The Harry Andersons were still looking for land in mid-1975, as were the Ed Sarrazins, the John Schuhmachers, Jr., and Edgar and Eva Marie Melchor Roitsch whose land holdings had been passed down from Joseph Biegel (Fayette County Record April 11, 1975).

Among the largest land holders were Adolph and Bennie Schmidt, who in mid-1975 were still in litigation with LCRA over the price for the nearly 1,000 acres of Schmidt land. The Schmidt Family had moved onto some of the original Bernhard Scherer lands "on a nice, cold day on January 1, 1929." The brothers grew up on the land, and in World War II both of them served in the armed forces. When they returned home, they began building up their Hereford herd. Through years of hard work, brush had been cleared from around the motts of huge oaks, and stock ponds, deep wells and cross fencing had been added to the land. Fields of Coastal Bermuda grass had been planted and Pensacola Bahia grass was being experimented with (Schmidt, 1975).

Where originally there had been a one-room bootlegger's shack, the Schmidts had added houses and outbuildings for themselves. Parts of the land rose so high that Monument Hill, some 10 miles away at La Grange, would be sighted at night, as could the lights of distant Weimar. The only land which the Schmidts retained in 1975 consisted of 30 acres with no highway frontage. Adolph and his family moved into a mobile home in the Park community and Bennie was living temporarily in a friend's home which was, also, soon to be taken into the plant area. Adolph and Bennie Schmidt, after some forty years of close association with their land, hoped only to find a new place where their cattle could maintain themselves twelve months of the year on their own. The Schmidts "reckoned" that they could not again "carve a place out of the raw land," not at their ages (Schmidt, 1975)."

9. A description and analysis of alternatives that would avoid the adverse effect.

For the mine and conveyor: Alteration of the mine plan, including omitting some areas proposed to be mined would avoid adverse impacts partly. Alternate placement of sediment ponds, diversions, haul roads, and other ancillary facilities to avoid disturbance could be carried out. It is possible to have areas avoided within a mine area; such is specifically provided for in the Surface Mining Conservation and Reclamation Act with prescribed buffers, generally 300 feet. Some protection could be given if variances to the prescribed buffers are not allowed. In ancillary facilities areas, alternative plans to avoid sites could be achieved.

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For the ash disposal area: the consultants have recommended avoidance by 300 foot buffer. Specific stipulations will be needed for the sites at lower elevations.

For the plant and Cedar Creek cooling lake: Adverse impacts have already occurred. For Baylor Creek Reservoir: Change in dam site or elevation filling or sealing of some sites would avoid some impacts.

For the transmission lines proposed: Rerouting may be necessary to avoid significant historic sites near the Round Top area. Avoidance of direct impacts could be obtained for prehistoric sites by filling over or padding and fencing. It may be necessary in some cases to make amendments to R-O-W easements to provide for protection of sites,

10. A description and analysis of alternatives that would mitigate the adverse effects:

Numerous measures will be necessary to even partially mitigate the adverse effects. Data recovery for prehistoric sites will require search for unexposed sites believed to occur in the area, excavation with complete recordation of stratification and features of aboriginal life, carbon dating of organic material remains, curation of all information to be available for further research. Monitoring during excavation for other unknown sites will be necessary. For Historic period sites, archeological investigations, on-site data recovery, complete photographing of resources, architectural drawings, archival work, tree ring studies, oral history may be utilized. It may be necessary to require security at some sites. Some adverse effects such as loss of family and community lifeways and customs, loss of community feeling and ethnic culture values and the association between existing people and the land, cannot be mitigated.

11. An estimate of the cost of the undertaking, identifying Federal and non-Federal shares.

Based on information provided by LCRA the cost of the undertaking is $

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MEMORANDUM OF AGREEMENT

WHEREAS, The Environmental Protection Agency (EPA), Region 6 has determined that the Lower Colorado River Authority undertaking, including the Fayette Power Project and the Cummins creek Mine, will have an adverse effect upon properties of the Fayette Power/Rabbs-Cummins Creek Mine Historic District which is eligible for inclusion in the National Register of Historic Places and has requested the comments of the Advisory Council on Historic Preservation pursuant to Section 106 of the National Historic Preservation Act (16 U.S.C. 470) and its implementing regulation, "Protection of Historic and Cultural Properties" (36 CFR Part 800).

NOW, THEREFORE, EPA, Region 6, the Texas Historic Preservation Officer, and the Advisory Council on Historic Preservation agree that the undertaking shall be implemented in accordance with the enclosed stipulations in order to take into account the effect of the undertaking on historic properties.

Execution of this Memorandum of Agreement evidences that the EPA, Region 6 has afforded the Council a reasonable opportunity to comment on the project and its effects on historic properties, and that EPA, Region 6 has taken into account the effects of the undertaking on historic properties.

Regional Administrator
Environmental Protection Agency
Date

Texas Historic Preservation
Officer
Date

Executive Director
Advisory Council on Historic
Preservation
Date

Draft

Chairman
Advisory Council on Historic Preservation
Date

Concurring Parties:

Draft

Draft
Draft

STIPULATIONS

I. EPA will incorporate by reference the following conditions into existing and subsequent NPDES permits for the Lower Colorado River Authority Fayette Power Project and Cummins Creek Mine Project.

Note to Reviewers: Specific conditions are to be developed for compliance by LCRA for unsurveyed areas associated with the project, and for actions at specific properties, and for some types of properties.

Public comment is to be considered in development of conditions.

Draft
Draft

Surveys Methodology/Limitations

Prior to the field work, Texas Archeological Research Laboratory (TARL) site files and appropriate USGS topographic maps for Fayette County were examined for: 1) physiographic location and kinds of sites; and 2) locations of prehistoric or historic sites recorded in the study area. Maps of the study area, supplied by LCRA and TAS, included a 1":1000' landowner tract map, 1":1000' aerials, and USGS 7.5" topographic quadrangles. United States Department of Agriculture aerial photos 1940 and 1950 were used in determination of land use and settlement over the past 43 years.

Survey technique varied with the terrain. The most generally used procedure was to take bearings on fencelines, align the crew perpendicular to the fenceline at 30 m intervals, and walk the length and width of the property using a zig-zag pattern to increase the area scanned. Along drainages, surveyors walked parallel to the creek on each side in order to observe cut banks and terraces.

At some prehistoric sites, shovel probes were dug to gain a preliminary assessment of the extent and depth of subsurface cultural deposits. Probe content were screened through 1/4" mesh screen, recorded by level. Probe locations were plotted on the site map with bearing and distance measured to a relocatable datum.

All sites were plotted topographic, aerial and tract maps. All were recorded on University of Texas site survey forms, mapped and photographed. In the lab, all relevant data were transferred to Texas Historical Commission site forms. Sites were assigned permanent site numbers in the trinomial numbering system, i.e., 41 = Texas, FY = Fayette County, 1 = series number of site found within the county.

Artifacts that were functionally or temporally diagnostic were collected. The density and distribution of non-diagnostic material was noted on the forms. Descriptions of the collected artifacts are based on comparisons with established types as discussed in Jelks (1962), Prewitt (1982), Suhm and Jelks (1962) and Weir (1976a) and with similar types reported from sites within the region (Fullem 1977; Hall 1981; Honea 1961).

Specific history of the survey area was recorded using a combination of cadastral maps, tax archive data, land title abstracts and deed records in the Fayette County court house. Some biographical data was obtained through correspondence with descendants of original settlers. Documentation is curated at TARL, UT at Austin. Complications/limitations to Surveys. Unequal coverage of the proposed project area has occurred. Access to survey approximately 2,100 acres of the mine area has not been obtained. Additional unsurveyed areas include the proposed conveyor corridor, Baylor Reservoir, and transmission lines. Ground visibility was limited in some areas in the north by dense cedar brakes and greenbriar, and by dense ground cover of leaf litter and pasture grasses.

There are previous losses at some prehistoric sites due to manmade development, including gravel quarrying through the Historic Period. Loss of historic structures has occurred. In the mine area, the Drawe House was moved after initial recordation and recommendation by surveyors as significant for its architectural information.

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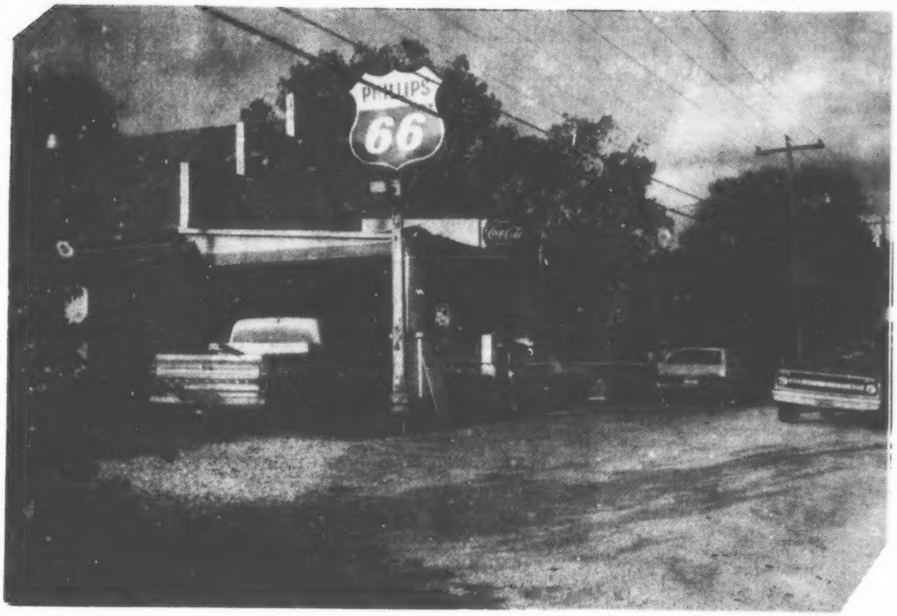
PHILLIPS
66
Coca-Cola

Meinen's Station - Warrenton

APPENDIX G

HYDROLOGY

CUMMINS CREEK - SURFACE WATER QUALITY CRITERIA FOR BLUEGILL SUNFISH

Metal	EPA(ug/l)			Conv. Fact.**	Texas (ug/l)
	24-hr Avg.	NTE*	LC_{50}		
Arsenic	-----	440	15,370	0.05	768.5
Beryllium	-----	-----	6,650***	0.05	332.5
Cadmium	0.025	3.0	21,000	0.05	1050
Copper	5.6	22	8,300	0.05	415
Lead	3.8	170	232,900***	0.05	11645
Mercury	0.2	4.1	150****	0.05	7.5
Nickel	96	1800	39,600	0.05	1980
Selenium	35	260	28,500	0.05	1425
Thallium	-----	-----	121,000	0.05	6050

* Not to exceed anytime.

** For persistent toxicants, the concentrations should not exceed 1/20 of the 96-hour LC_{50} (Texas Surface Water Quality Standards, Apr '81, pp 5-6).

*** Based on average hardness.

**** Fathead minnow.

SOURCE: Federal Water Pollution Control Administration. 1968. Water Quality Criteria. Report of the National Technical Advisory Committee to the Secretary of the Interior. Wash, D.C. April 1.

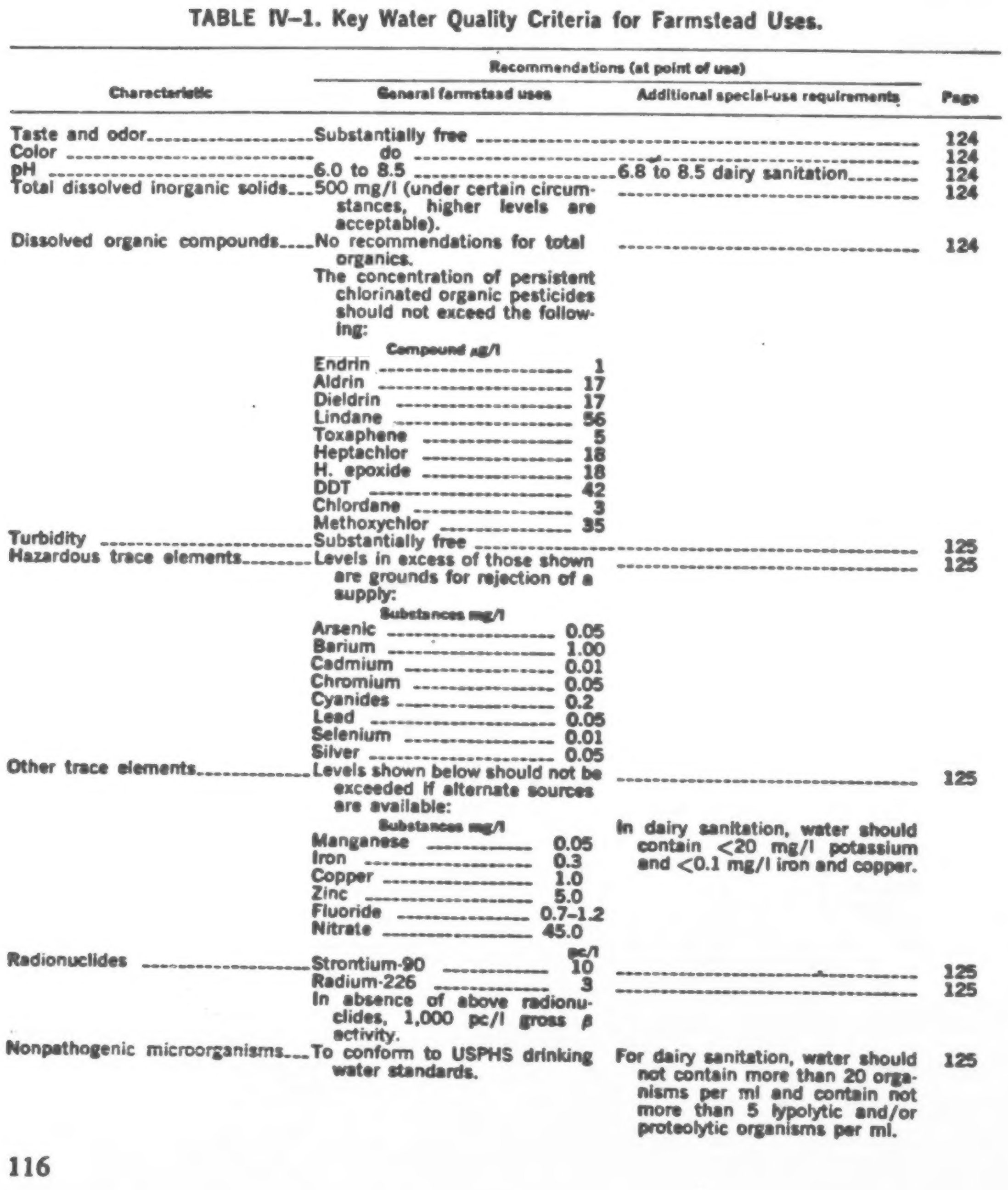

TABLE IV–1. Key Water Quality Criteria for Farmstead Uses.

Characteristic	Recommendations (at point of use)		Page
	General farmstead uses	Additional special-use requirements	
Taste and odor	Substantially free		124
Color	do		124
pH	6.0 to 8.5	6.8 to 8.5 dairy sanitation	124
Total dissolved inorganic solids	500 mg/l (under certain circumstances, higher levels are acceptable).		124
Dissolved organic compounds	No recommendations for total organics. The concentration of persistent chlorinated organic pesticides should not exceed the following: Compound µg/l Endrin 1 Aldrin 17 Dieldrin 17 Lindane 56 Toxaphene 5 Heptachlor 18 H. epoxide 18 DDT 42 Chlordane 3 Methoxychlor 35		124
Turbidity	Substantially free		125
Hazardous trace elements	Levels in excess of those shown are grounds for rejection of a supply: Substances mg/l Arsenic 0.05 Barium 1.00 Cadmium 0.01 Chromium 0.05 Cyanides 0.2 Lead 0.05 Selenium 0.01 Silver 0.05		125
Other trace elements	Levels shown below should not be exceeded if alternate sources are available: Substances mg/l Manganese 0.05 Iron 0.3 Copper 1.0 Zinc 5.0 Fluoride 0.7–1.2 Nitrate 45.0	In dairy sanitation, water should contain <20 mg/l potassium and <0.1 mg/l iron and copper.	125
Radionuclides	pc/l Strontium-90 10		125
	Radium-226 3 In absence of above radionuclides, 1,000 pc/l gross β activity.		125
Nonpathogenic microorganisms	To conform to USPHS drinking water standards.	For dairy sanitation, water should not contain more than 20 organisms per ml and contain not more than 5 lypolytic and/or proteolytic organisms per ml.	125

TABLE IV–2. Key Water Quality Criteria for Livestock Use

Characteristic	Recommendations
Total dissolved solids (TDS)	<10,000 mg/l, depending upon animal species and ionic composition of the water.
Hazardous trace elements:	
Arsenic	<0.05 mg/l
Cadmium	<0.01 mg/l
Chromium	<0.05 mg/l
Fluorine	<2.40 mg/l
Lead	<0.05 mg/l
Selenium	<0.01 mg/l
Organic substances:	
Algae (water bloom)	Avoid abnormally heavy growth of blue-green algae.
Parasites and pathogens.	Conform to epidemiological evidence.
Dissolved organic compounds.	Biological accumulation from environmental sources, including water, shall not exceed established, legal limits in livestock products.
Radionuclides	Conform to recommendations for farmstead water supplies.

TABLE IV–3. Suggested Guidelines for Salinity in Irrigation Water

Crop response	TDS mg/l	EC [1] mmhos/cm
Water for which no detrimental effects will usually be noticed	<500	<0.75
Water which can have detrimental effects on sensitive crops	500–1,000	0.75–1.50
Water that may have adverse effects on many crops and requiring careful management practices	1,000–2,000	1.50–3.00
Water that can be used for salt-tolerant plants on permeable soils with careful management practices	2,000–5,000	3.00–7.50

[1] Electrical conductivity.

ues above 4 may be detrimental because of sodium phytoxicity (pp. 155, 164). Water low in salt but high in bicarbonate content may present a permeability hazard even with low SAR values (pp. 170–171).

Chlorides

Although not phytoxic to most crops, some chloride phytotoxicity has been found for some fruit crops. No limit has been established for chloride-tolerant crops because detrimental effects from salinity *per se* ordinarily deter crop growth first. For chloride-sensitive crops, chloride content in the soil solution may range from 10 to 50 me/l with permissible levels in irrigation water ranging from 1 to 20 me/l (*16*). More restrictive criteria should be considered where sprinkler irrigation is used (pp. 155–156).

Trace Elements

Toxic limits which would be generally applicable to all soils and all crops are not easily defined. Research literature is inadequate to permit even well-defined guidelines. The limits suggested in table IV–15 are tentative and are designed only to serve as guides for well-drained soils (p. 152).

Radionuclides

There are many considerations involved regarding radioactivity in irrigation water (pp. 163–164). One hazard is the potential accumulation of a radionuclide in a soil reaching levels in excess of that applied in the irrigation water. On the basis of existing knowledge, USPHS Drinking Water Standards (*175*) is the best guide; the standards are: Strontium-90, 10 pc/l; radium-226, 3 pc/l. In the absence of these radionuclides, 1,000 pc/l gross beta activity.

Microorganisms

It is impractical to monitor irrigation water for the numerous pathogenic organisms which may be present (pp. 160–163). For this reason, the following guidelines for coliform limitations are suggested for interim use subject to research confirmation. These are especially applicable where the tops or roots of the irrigated crop are to be consumed directly by man or livestock. The monthly arithmetic average density of the coliform group of bacteria shall not exceed 5,000 per 100 milliliters and the monthly arithmetic average density of fecal coliforms shall not exceed 1,000 per 100 milliliters. Both of these limits shall be an average of

SOURCE: Environmental Protection Agency, 1972.
Water Quality Criteria 1972. Wash, D.C.

that citrus was more sensitive (Aldrich et al. 1951,[366] Bradford 1963b,[381] Hilgeman et al. 1970[415]). Hilgeman et al. (1970)[415] found that grapefruit developed severe symptoms of lithium toxicity when irrigated with waters containing lithium at 0.18 to 0.25 mg/l. Bradford (1963a)[380] reported that experience in California indicated slight toxicity of lithium to citrus at 0.06 to 0.10 mg/l in the water.

Lithium is one of the most mobile of cations in soils. It tends to be replaced by other cations in waters or fertilizers and is removed by leaching. On the other hand, it is not precipitated by any known process.

Recommendations

Recommendations for maximum concentrations of lithium, based on its phytotoxicity, are 2.5 mg/l for continuous use on all soils, except for citrus where the recommended maximum concentration is 0.075 mg/l for all soils. For short-term use on fine textured soils the same maximum concentrations are recommended because of lack of inactivation in soils.

Manganese

Manganese concentrations at a few tenths to a few milligrams per liter in nutrient solutions are toxic to a number of crops as shown by Morris and Pierre (1949),[140] Adams and Wear (1957),[364] Hewitt (1965),[414] and others. However, toxicities of this element are associated with acid soils, and applications of proper quantities of ground limestone successfully eliminated the problem. Increasing the pH to the 5.5 to 6.0 range usually reduced the active manganese to below the toxic level (Adams and Wear 1957).[364] Hoyt and Nyborg (1971b)[420] found that available manganese in the soil and manganese content of plants were negatively correlated with soil pH. However, the definite association of toxicity with soil pH as found with aluminum was not found with manganese, which has a more complex chemistry. Thus, more care must be taken in setting water quality criteria for manganese than for aluminum (i.e., management for control of toxicities is not certain).

Recommendations

Recommended maximum concentrations for manganese in irrigation waters are set at 0.20 mg/l for continued use on all soils and 10 mg/l for use up to 20 years on neutral and alkaline fine textured soils. Concentrations for continued use can be increased with alkaline or calcareous soils, and also with crops that have higher tolerance levels.

Molybdenum

This element presents no problems of toxicity to plants at concentrations usually found in soils and waters. The problem is one of toxicity to animals from molybdenum ingested from forage that has been grown in soils with relatively high amounts of available molybdenum. Dye and O'Hara (1959)[398] reported that the molybdenum concentration in forage that produced toxicity in ruminants was 5 to 30 mg/kg. Lesperance and Bohman (1963)[430] found that toxicity was not simply associated with the molybdenum content of forage but was influenced by the amounts of other elements, particularly copper. Jensen and Lesperance (1971)[423] found that the accumulation of molybdenum in plants was proportional to the amount of the element added to the soil.

Kubota et al. (1963)[426] found that molybdenum concentrations of 0.01 mg/l or greater in soil solutions were associated with animal toxicity levels of this element in alsike clover. Bingham et al. (1970)[376] reported that molybdosis of cattle was associated with soils that had 0.01 to 0.10 mg/l of molybdenum in saturation extracts of soils.

Recommendations

The recommended maximum concentration of molybdenum for continued use of water on all soils, based on animal toxicities from forage, is 0.010 mg/l. For short term use on soils that react with this element, a concentration of 0.050 mg/l is recommended.

Nickel

According to Vanselow (1966b),[474] many experiments with sand and solution cultures have shown that nickel at 0.5 to 1.0 mg/l is toxic to a number of plants. Chang and Sherman (1953)[385] found that tomato seedlings were injured by 0.5 mg/l. Millikan (1949)[137] found that 0.5 to 5.0 mg/l were toxic to flax. Brenchley (1938)[382] reported toxicity to barley and beans from 2 mg/l. Crooke (1954)[395] found that 2.5 mg/l was toxic to oats. Legg and Ormerod (1958)[429] found that 1.0 mg/l produced toxicity in hop plants. Vergnano and Hunter (1953)[475] found that 1.0 mg/l in solutions flushed through sand cultures was toxic to oats. Soane and Saunders (1959)[466] found that tobacco plants showed no toxicity at 30 mg/l, and that corn showed no toxicity at 2 mg/l but showed toxicity at 10 mg/l.

Work by Mizuno (1968)[439] and Halstead et al. (1969)[409] and the review of Vanselow (1966b)[474] showed that increasing the pH of soils reduces the toxicity of added nickel.

Halstead et al. (1969)[409] found the greatest capacity to adsorb nickel without development of toxicity was by a soil with 21 per cent organic matter.

Recommendations

Based on both toxicity in nutrient solutions and on quantities that produce toxicities in soils, the recommended maximum concentration of nickel in irrigation waters is 0.20 mg/l for continued use on all soils. For neutral fine textured soils for a period up to 20 years, the recommended maximum is 2.0 mg/l.

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Effluent Characteristic	Discharge Limitations		Monitoring Requirements	
	Other units (specify)		Measurement Freq.	Sample Type
	Daily Avg	Daily Max		
Flow-m^3/Day (MGD)	Report Flow		1/week	Grab
Total Suspended Solids	30 mg/l	45 mg/l	1/week	Grab
Biochemical Oxygen Demand (5-day)	30 mg/l	45 mg/l	1/week	Grab
pH	Not less than 6.0 standard units nor greater than 9.0 standard units		1/week	Grab

Page 6-75, the TDWR allowable concentrations given in Table 6-15 were for daily averages (of multiple samples in a 24-hour period) when the applicable standards are for grab samples, i.e., the concentration of an individual sample collected in less than 15 minutes. Insert the following standards:

Revised Table 6-15 (in part)

Metal	TDWR Allowable Concentration, Grab Sample (ppm)[2,4]
Manganese	3.0
Selenium	0.2
Arsenic	0.3
Cadmium	0.2
Chromium	5.0
Lead	1.5
Mercury	0.01
Zinc	6.0

[2] ppm - parts per million

[4] SOURCE: Texas Department of Water Resources, 1979. Permanent Rules, as amended. Section 156.19.15.002. Austin, Texas.

EPA NPDES Permit Rationale
Using Ferruginous Mine Standards

NPDES Permit No. TX0095591
Lower Colorado River Authority
Cummins Creek Mine

Outfalls 001 - 009

Effluent limitations are based on New Source Performance Standards for Acid or Ferruginous Drainage (Part 434.35) under Subpart C of the Coal Mining Point Source Category. These include:

Pollutant	Daily Avg.	Daily Max.
Total Suspended Solids	35.0 mg/l	70.0 mg/l
Iron, Total	3.0 mg/l	6.0 mg/l
Manganese, Total	2.0 mg/l	4.0 mg/l
pH	within the range of 6.0 to 9.0 S.U.	

8/13/84

SOURCE: EPA. 1976. National Interim Primary Drinking Water Regulations.

PRIMARY STANDARDS

	MCL
Arsenic	0.05 mg/l
Barium	1.00 mg/l
Cadmium	0.01 mg/l
Chromium	0.05 mg/l
Lead	0.05 mg/l
Mercury	0.002 mg/l
Selenium	0.01 mg/l
Silver	0.05 mg/l
Fluoride	1.4 - 2.4 depending on average temperature
Nitrate as N	10.00 mg/l
Coliform Bacteria	a) For standard samples (100ml) the arithmetic means of all samples examined in a compliance period shall not exceed one colony. b) When less than 20 samples per month are examined, not more than one sample shall have a coliform count in excess of 4 per 100 ml.
Turbidity	1 TU (turbidity unit)
Endrin	0.0002 mg/l
Lindane	0.004 mg/l
Methoxychlor	0.10 mg/l
Toxaphene	0.005 mg/l
2,4 - D	0.10 mg/l
2,4,5-TP (Silvex)	0.01 mg/l
TTHM (total trihalomethanes)	0.10 mg/l
Combined Radium - 226 and Radium - 228	5 pCi/l*
Gross Alpha Particle Activity (including radium-226, excluding radon and uranium)	15 pCi/l
Beta Particle and Photon Radioactivity from manmade radionuclides	average annual conc. shall not produce an annual dose equivalent to the total body or any internal organ greater than 4 millirem/year
Tritium (total body)	20,000 pCi/l
Strontium-90 (bone marrow)	8 pCi/l

*pCi/l = picocuries/liter

SECONDARY STANDARDS

Chloride	250 mg/l
Color	15 color units
Copper	1 mg/l
Corrosivity	noncorrosive
Foaming Agents	0.5 mg/l
Iron	0.3 mg/l
Manganese	0.05 mg/l
Odor	3 threshold odor number
pH	6.5 - 8.5
Sulphate	250 mg/l
Total Dissolved Solids (TDS)	500 mg/l
Zinc	5 mg/l

DATE: 07/06/84

ENVIRONMENTAL PROTECTION AGENCY
REGION 6
STREAM SEGMENTS AND STANDARDS SUMMARY

SEGMENT NUMBER & DESCRIPTION: TX1402 COLORADO RIVER
ABOVE TIDAL TO TOM MILLER DAM INCL TOWN LK

SEGMENT USES:

PCR = PRIMARY CONTACT RECREATION
SCR = SECONDARY CONTACT RECREATION
FWP = FISH & WILDLIFE PROPAGATION
DWS = DOMESTIC WATER SUPPLY

CODES	UNITS	DESCRIPTIONS	------ STANDARDS ------	
			LO VALUE	HI VALUE
00010	CENT	WATER TEMP		
00061	CFS	STREAM FLOW		35
00300	MG/L	DISSOLVED OXYGEN	74.8	
00400	SU	PH	5.0	
00940	MG/L	CHLORIDE	6.5	9.0
00945	MG/L	SULFATE		100
31616	#/100ML	FECAL COLIFORM		75
70300	MG/L	TOTAL DIS. SOLIDS		200
				500

WELCOME
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High School - Fayetteville

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